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ANALYSIS OF HORIZONTAL SHEAR DATA.(U)
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Analysis of Horizontal Shear Data.

by

J. K. Lewis

~~and~~

A. D. Kirwan

Final Report, for contract
N00014-81-C-2102

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1. Introduction

The purpose of this study was to assess the value of drifter data taken by NRL for determining horizontal shears in the ocean. In the course of the study, we have addressed two general issues. The first issue is an evaluation of shears from the smoothed data supplied by NRL along with an assessment of the significance of these evaluations. The other issue is a general assessment of the use of drifters for inferring horizontal shears.

There are a number of interrelated questions concerning these issues. The more salient of these are: How representative of natural conditions is the smoothed data set? What effect does the smoothing procedure have on the results? Is the theoretical basis of the analysis sound? What does the analysis tell us about physical processes occurring in the ocean? It appeared that three tasks were required to resolve these issues. These were:

Task 1) Perform an analysis on drogues 1, 3, 5, 9, 16 and 20 to obtain the differential kinematic properties (shear deformation, normal deformation, vorticity, and horizontal divergence) in a geographic coordinate system (i.e. north and east components). These are presented in tables and accompanied by graphs of the functions versus time. Two clusters ~~are analyzed~~. One was a small-scale cluster composed of drifters 1, 3 and 5. The other was a large-scale cluster composed of 1, 9 and 16.

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2. Background

2.1 Theoretical Basis of Analysis.

The raw data obtained from drifters are estimates of position at discreet times. If a cluster of drifters are located within a small parcel of the ocean, then a Taylor's expansion yields for the velocity of the i^{th} drifter (Molinari and Kirwan (1975), Okubo and Ebbesmeyer (1976))

$$U_i=U+g_i+[(D+N)X_i]/2+[(S-\zeta)Y_i]/2$$
$$V_i=V+h_i+[(S+\zeta)X_i]/2+[(D-N)Y_i]/2$$
$$i=1,\ldots,n. \qquad (1)$$

The U and V are the components of the velocity of the center of mass of the parcel; the coordinates with respect to the cluster center of mass of drifter i are X_i and Y_i; and g_i and h_i represent the sum of the higher order nonlinear terms in the expansion. From the experimental standpoint, these terms also include measurement errors and, perhaps, random turbulent motion. In these equations, the velocity gradients across the parcel have been expressed in terms of the elementary differential kinematic properties (DKP):

$D=\partial u/\partial x+\partial v/\partial y$ (divergence)
$\zeta=\partial v/\partial x-\partial u/\partial y$ (vorticity)
$S=\partial v/\partial x+\partial u/\partial y$ (shearing deformation rate)
$N=\partial u/\partial x-\partial v/\partial y$ (normal or stretching deformation rate)

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changes without change of area or orientation are given by S and N respectively. The former is for the shape change produced by differential motions parallel to the boundaries, while the latter is for motions normal to the boundaries.

The physical picture given by the model equations is that an individual drifter's velocity is composed of the mean translatory velocity of the parcel, plus a velocity induced by the rotation, divergence, and distortion of the parcel, plus a random or turbulent velocity. The mean parcel velocity is attributed to large-scale (relative to cluster size) motions, the induced velocity to cluster-scale motions, and the random component to the small-scale turbulent field. The scale of these latter motions is assumed to be much less than that of the cluster.

Of course, the DKP in (1) vary as a function of time. However, the analysis procedure (described below) requires that their time scales of variation be larger than that of the velocities. At this time there is no way of establishing that this is true for the ocean. In practice, one makes fixes as often as possible and hopes for the best. Otherwise it would be necessary to incorporate the method of stationary phase in the analysis. Such an effort is not justified under the goals of the study.

In (1) the velocity for the i^{th} drifter was calculated by taking centered differences of the smoothed position data:

$$\begin{aligned} U_i(t) &= [x_i(t+\Delta t) - x_i(t-\Delta t)]/2\Delta t \\ V_i(t) &= [y_i(t+\Delta t) - y_i(t-\Delta t)]/2\Delta t \end{aligned} \qquad (2)$$

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Also, the average velocity components were calculated from

$$U=\left(\sum_{i=1}^{n} U_i\right)/n$$
$$V=\left(\sum_{i=1}^{n} V_i\right)/n \qquad (3)$$

where n is the total number of drifters. Finally, the drifter positions with respect to the center of the cluster or origin for (1) is

$$X_i=x_i-\sum x_i/n$$
$$Y_i=y_i-\sum y_i/n \qquad (4)$$

Thus, in (1), U, V, U_i, V_i, X_i and Y_i are known from measurements at each discreet time. The DKP can be calculated by minimizing the residual kinetic energy term $E \equiv \sum_{i=1}^{n}(g_i^{\,2} + h_i^{\,2})/2$ (5)

This, however, is not a standard least squares problem since there may be measurement errors in both the velocities and the positions. Moreover, depending upon the analysis procedure, the position and velocity errors may be correlated (Kirwan and Chang, 1979).

Let us see how these errors may affect the analysis. First we express the observed positions as sums of the true values and random errors (for least squares, errors in the velocities can be incorporated in g_i and h_i). We can write

$$X_i/2 = \tilde{X}_i + \alpha_i$$
$$Y_i/2 = \tilde{Y}_i + \beta_i \qquad (6)$$

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Next, substitute (6) into (1) to obtain

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\begin{aligned}
u_i &= (D+N)\,(\tilde{X}_i + \alpha_i) + (S-\zeta)\,(\tilde{Y}_i + \beta_i) + g_i \\
v_i &= (S+\zeta)\,(\tilde{X}_i + \alpha_i) + (D-N)\,(\tilde{Y}_i + \beta_i) + h_i
\end{aligned}
\qquad (7)
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u_i &= U_i - U \\
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are the drifter velocity components with respect to the center of mass of the cluster. The least squares equations for the DKP give

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\frac{D+N}{2} = \begin{vmatrix} (\overline{ux} + \sigma_{ux}) & (\overline{xy} + \sigma_{xy}) \\ (\overline{uy} + \sigma_{uy}) & (\overline{y^2} + \sigma_y^2) \end{vmatrix} / \Delta
$$

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$\overline{ux}$, $\overline{uy}$, $\overline{vx}$, $\overline{vy}$, $\overline{x^2}$, $\overline{y^2}$, and $\overline{xy}$ are estimates from the observations of the true values of the appropriate correlations. The σ's are variances and covariances of the measurement errors in these estimates. (Equations (8) correct algebraic mistakes in Kirwan and Chang, 1979).

Several points should be noted about (8). First, if $\alpha_i \equiv \beta_i \equiv 0$ (i.e. the position measurements are exact), then the equations reduce to the usual normal equations for multivariate least squares. Second, if the position errors are known but are uncorrelated with the velocity errors, then the estimates of the DKP provided by (8) will be less than the theoretic estimate given by

$$\frac{D+N}{2} = \begin{vmatrix} \overline{ux} & \overline{xy} \\ \overline{uy} & \overline{y^2} \end{vmatrix} \Big/ \left(\overline{x^2}\,\overline{y^2} - \overline{xy}^2\right)$$

etc. However, this bias is easily removed by subtracting the known position error statistics from estimates of $\overline{x^2}$, $\overline{y^2}$ and $\overline{xy}$ obtained from the data.

In principle, unbiased estimates of the DKP may be obtained in the general case by correcting the velocity-position correlations for correlations of their errors. Unfortunately, these correlations are much harder to determine than the position error correlation matrix. Moreover, if the velocities are constructed from smoothed trajectories, the smoothing procedure may introduce a substantial correlation between the velocities and positions.

2.2 Analysis Procedures

The comments above emphasize the importance of proper planning of the data analysis. They suggest a data analysis flow diagram of the form

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\text{Raw Position Data} \arrow[ur] \arrow[dr] & & \text{DKP} \\
 & \text{Smoothed and interpolated velocities} \arrow[ur] &
\end{tikzcd}$$

Unfortunately, the usual procedure is to process the data in series rather than parallel. Thus velocities are normally not obtained directly from the raw position data but from smoothed and interpolated trajectories.

Our experience has shown that the effects of the procedure of serially processing data are two-fold. The first is that it may alter to a varying degree the magnitude of the elements of the velocity-position error correlation matrix

$$\begin{vmatrix} \sigma_{ux} & \sigma_{uy} \\ \sigma_{vx} & \sigma_{vy} \end{vmatrix} .$$

But the more serious effect is that it can produce long term trends in the matrix elements. This can hamper quantitative interpretations of the results in terms of physical mechanisms operating in the ocean. It is less likely that this would have as much an effect on qualitative studies such as establishing orders of magnitude of the DKP.

2.3 Sources of Error in Data

There are three potential sources of error in the data supplied to SAI by NRL. These are position errors, windage errors, and bias produced by the smoothing operator. NRL personnel (T. Gordon) has indicated that at-sea tests of the position fixing system suggest that the most probable position error is $\pm$ 350 m and that there is negligble correlation between north and east measurements.

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For this study, we have taken the most probable error as the rms error. In fact, this is probably an over-estimate since the smoothing routine will tend to reduce random position errors.

The windage problem was investigated by the procedures suggested by Kirwan et al. (1975). For the wind conditions encountered in this experiment and the type of buoy used, it was established that the windage effect was negligble.

From the data supplied, it was not possible to establish the effect of the smoothing operator on velocity errors or on the correlation of velocity and position errors. Despite this, it is felt that the data is sufficient to meet the objectives of the study.

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3. Critique of Data

3.1 General Considerations

Before discussing the results of the analysis, it is useful to summarize the essential characteristics of the data. They have played a role in the design of our procedures.

Gordon (1980) has described the procedure for smoothing and interpolating the raw position data. On the average, raw position data were taken every 4 hours. These data were then fitted by least squares polynomials ranging in degree from 3 to 7. These polynomials were then evaluated at hourly intervals. These smoothed and interpolated positions were subjected to a number of analyses as described below.

It has been our experience that polynomial fits, especially if the degree is low relative to the number of data points, is a satisfactory procedure for smoothing trajectory data. It should be noted that other techniques are available which, in our view, are superior. A discussion of other such options is outside the scope of this work.

There are, however, two characteristics of the data which have limited our ability to interprete quantatively physical processes in the ocean. One of these is that a separate parallel analysis was not made for trajectories and velocities. Problems arising from this characteristic were discussed in section 2.2. The other problem is that the interpolation procedure provided approximately 4 times more data points than were observed. This means that the data points have a built-in correlation with a lag of about 4 hours. This effect was minimized by running a special analysis utilizing every fourth point. This procedure also should reduce some-

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3.2 Discussion of trajectories

Trajectories of 5 drifters were analyzed. Drifters 9, 16 and 1 comprised what is called here the large-scale cluster. Drifters 1, 3 and 5 comprised a very small scale cluster on the western edge of the large-scale cluster. Because of their proximity to drifter 1, drifters 5 and 3 provided very little kinematic information for the large-scale cluster. Thus, two separate analysis were conducted, one on the large-scale cluster and one on the small-scale cluster.

Data from drifter 20 was also available for the last few hours of the experiment. Unfortunately, it provided little new kinematic information since it stayed in a line with drifters 9 and 16.

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4. Data Analysis

A number of analyses and tests were performed on the large- and small-scale clusters. These were designed both to assess the quality of the data as well as to obtain the DKP. The following sub-sections discuss pertinent aspects of these analyses and the results.

4.1 Shear and Normal Deformation Rates - Large-Scale Cluster

First we shall discuss calculations of the shear and normal deformation rates for the large-scale cluster. These calculations were made for both a geographic coordinate system (north and east) and then for a natural coordinate system oriented along and normal to the direction of flow of the cluster center of mass.

The purpose of the latter calculations was to see if there was a preference for shear or normal deformation in a natural coordinate system. Specifically, this test was designed to address the hypothesis that the dominant horizontal velocity gradient along frontal zones is shear. The test was accomplished by transforming both shear and normal deformation to a coordinate system in which the y axis is oriented along the instantaneous direction of motion of the cluster and the x axis points to high pressure.

If Θ is the angle between north and the direction of motion of the cluster, then the normal and shear deformation in the natural coordinate system can be found from

$$\begin{aligned} \overline{N} &= \left[N(V^2 - U^2) - 2SUV \right] / (U^2 + V^2) \\ \overline{S} &= \left[2NUV + S(V^2 - U^2) \right] / (U^2 + V^2) \end{aligned} \tag{9}$$

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$$\begin{aligned} \overline{N} &= \left[N(V^2 - U^2) - 2SUV \right] / (U^2 + V^2) \\ \overline{S} &= \left[2NUV + S(V^2 - U^2) \right] / (U^2 + V^2) \end{aligned} \tag{9}$$

Here Θ is given by

$$\Theta = \tan^{-1} (U/V) + \pi/2 \qquad (10)$$

In (9), the double angle, 2 Θ, trigonometric functions are expressed in terms of the velocity components (U,V) of the center of mass by use of (10).

The time histories of the shear and normal deformation rates are shown in Figs. 1a and 2a, respectively. Figs. 1b and 2b give the deformation rates with respect to the natural coordinate system.

Since an estimate of the rms position error was provided by NRL, we were able to correct the deformation rates for this factor as suggested by Kirwan and Chang (1979). These corrected deformation rates are given in Figs. 3a and 4a, respectively. Figs. 3b and 4b give the corrected deformation rates with respect to a natural coordinate system.

4.2 Shear and Normal Deformation Rates - Small-Scale Cluster.

The shear and normal deformation rates were calculated for the small-scale cluster for a geographic coordinate system only. Figs. 5 and 6 show that the results of the calculations are quite noisy. This indication was supported by calculations of the deformation rates after the correction for the position error (Figs. 7 and 8). These latter two figures show that the correction has altered substantially the time histories of the deformation rates.

4.3 Vorticity Balance - Large-Scale Cluster

The vorticity and divergence were calculated for the large-scale cluster, and a test was conducted to investigate the extent to which the vorticity equation, given below, is satisfied

$$\frac{d}{dt} (\zeta+f) + (\zeta+f) D = R \qquad (11)$$

Here Θ is given by

$$\Theta = \tan^{-1} (U/V) + \pi/2 \qquad (10)$$

In (9), the double angle, 2 Θ, trigonometric functions are expressed in terms of the velocity components (U,V) of the center of mass by use of (10).

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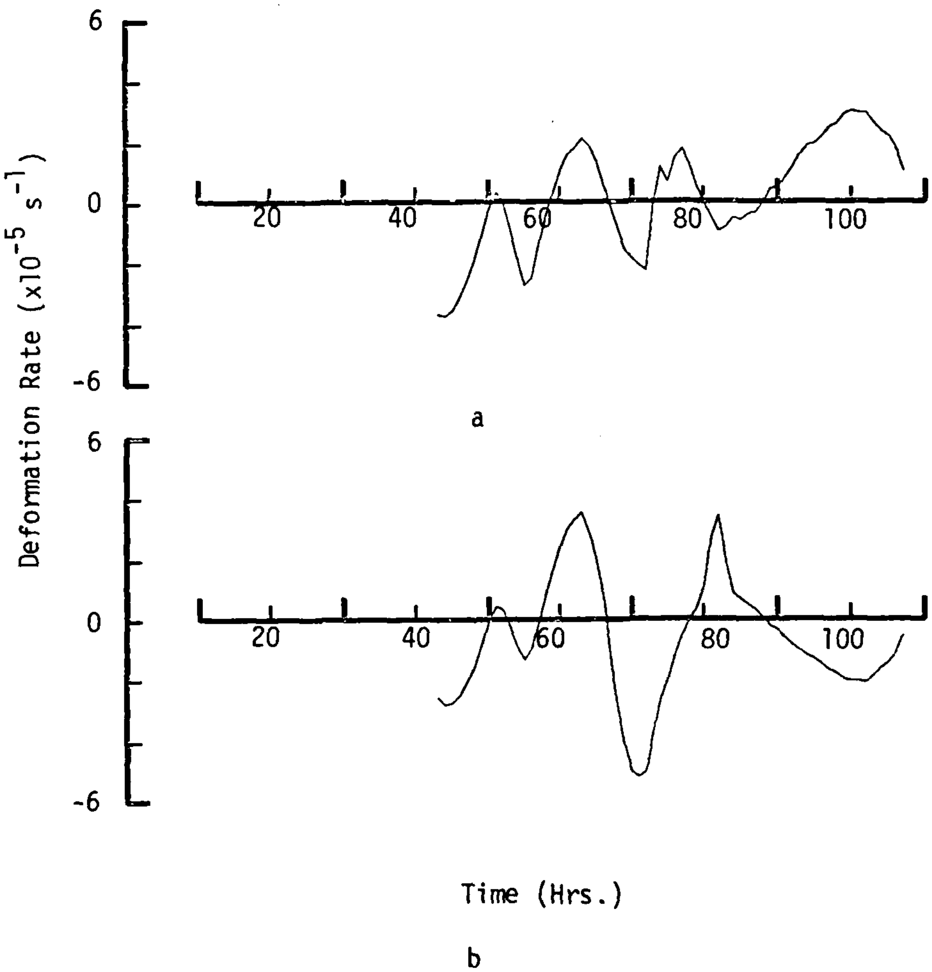
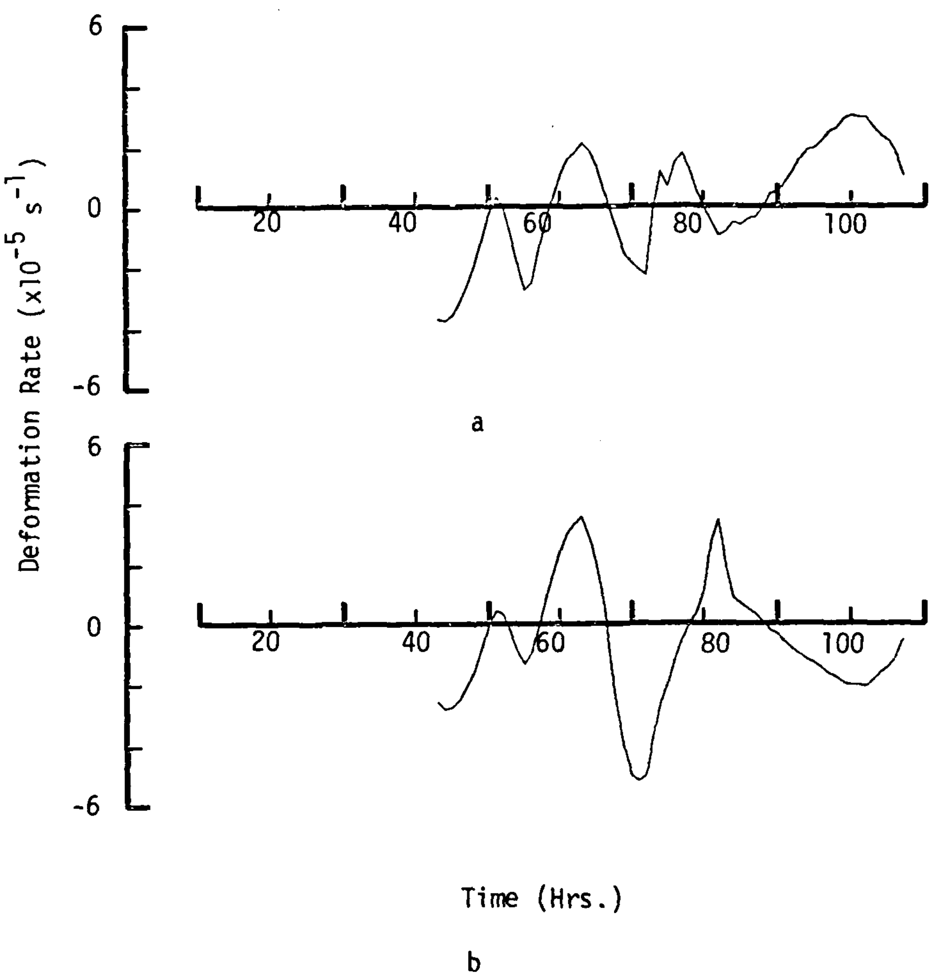


Fig. 1 Shear deformation rates for the large-scale cluster (without corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.



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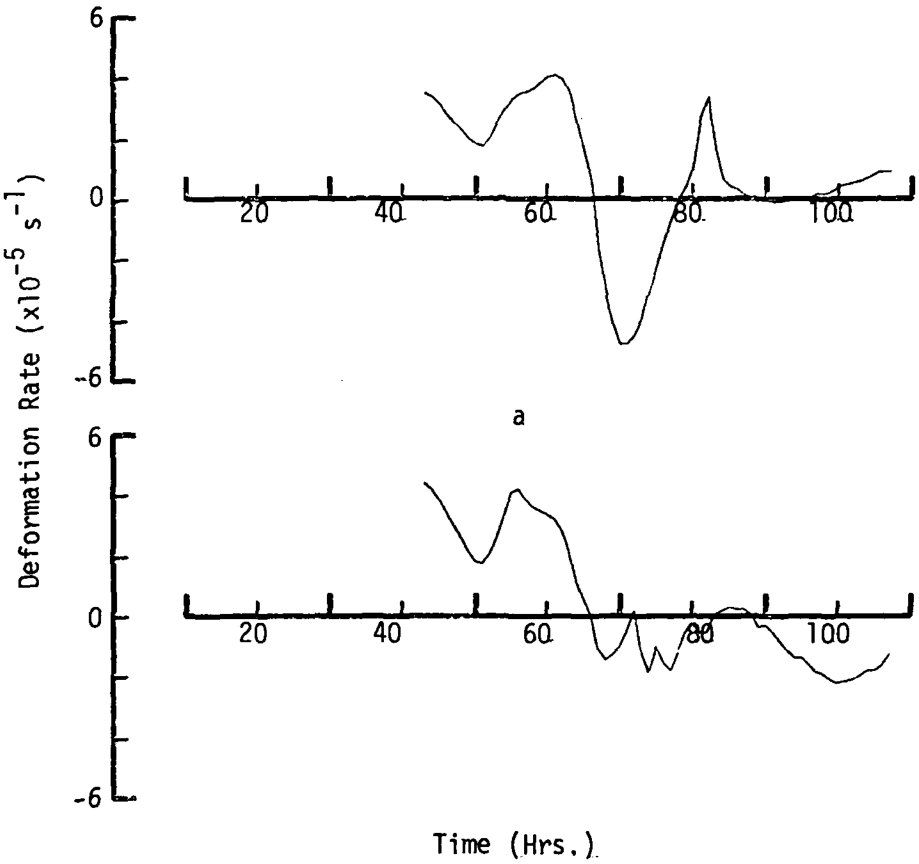
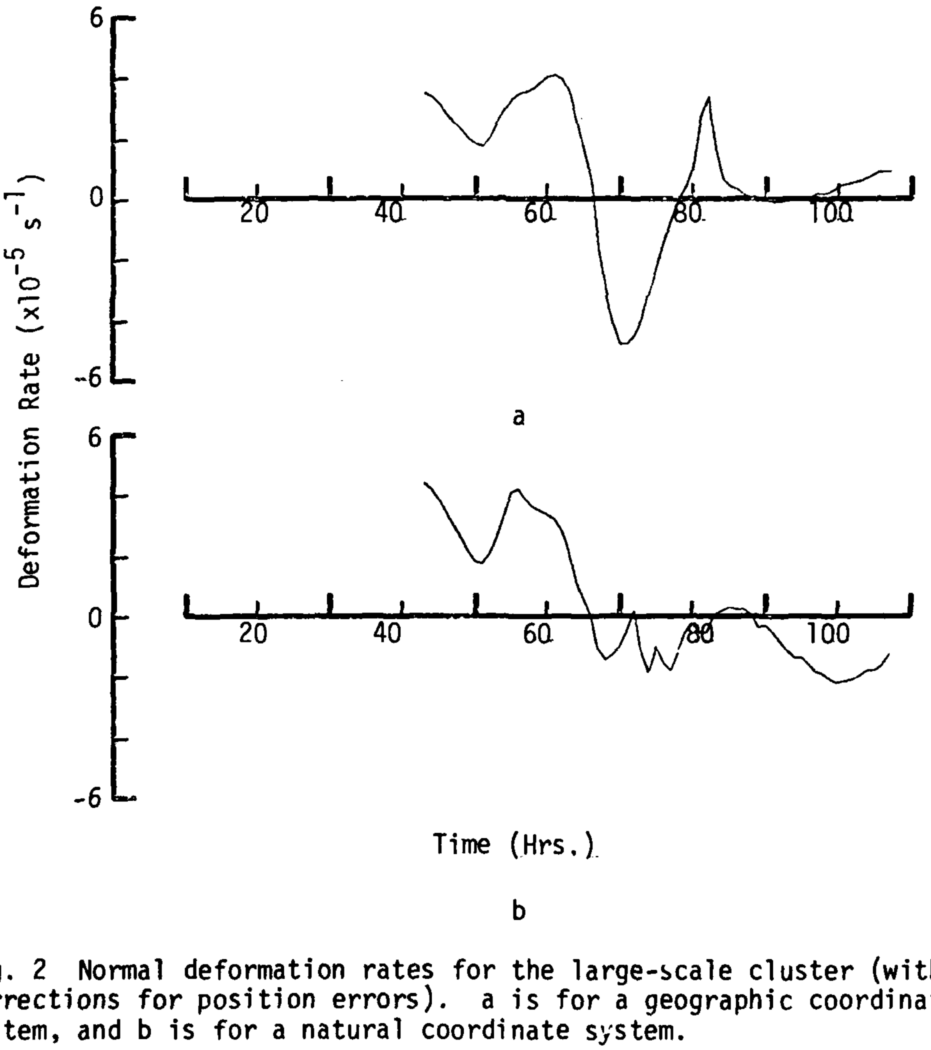


b

Fig. 2 Normal deformation rates for the large-scale cluster (without corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.



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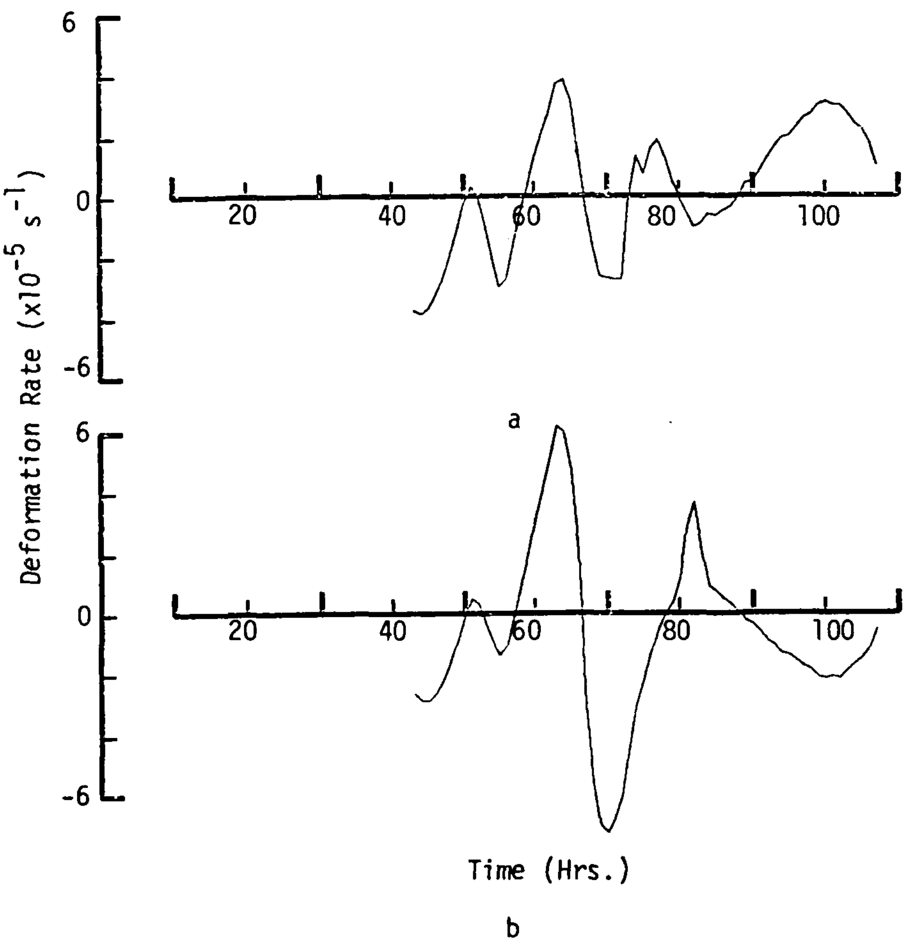
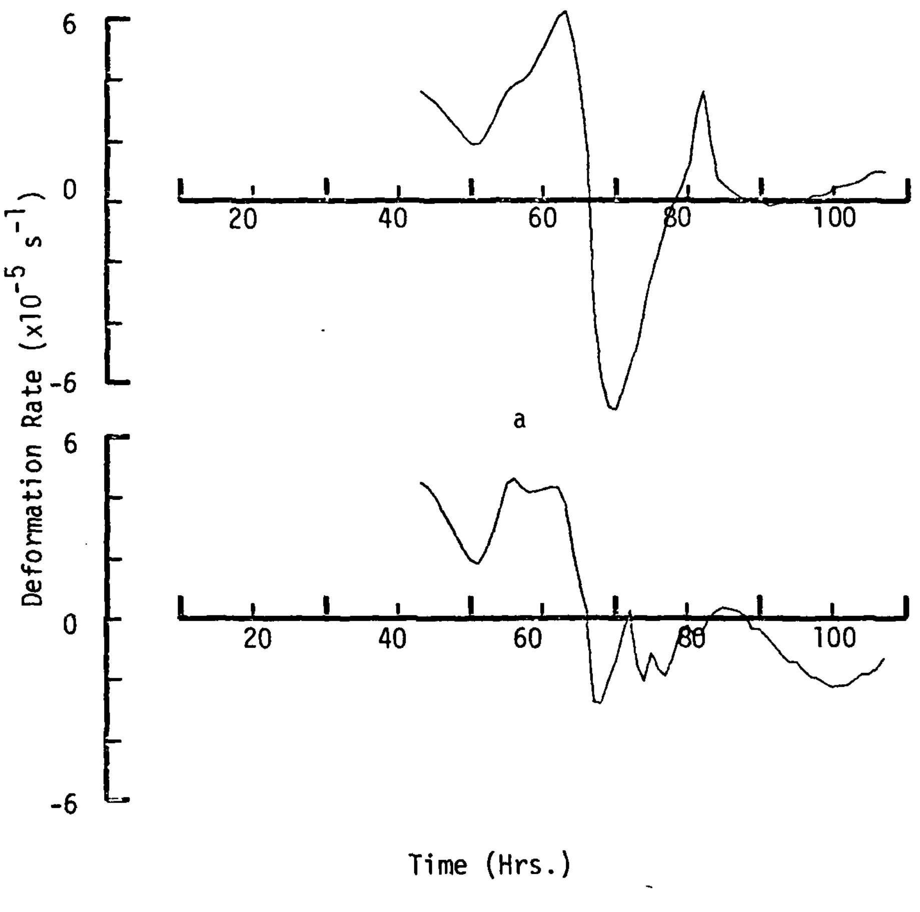


Fig. 3 Shear deformation rates for the large-scale cluster (with corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.



b

Fig. 4 Normal deformation rates for the large-scale cluster (with corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.

Fig. 5 Shear deformation rates for the small-scale cluster (without corrections for position errors).

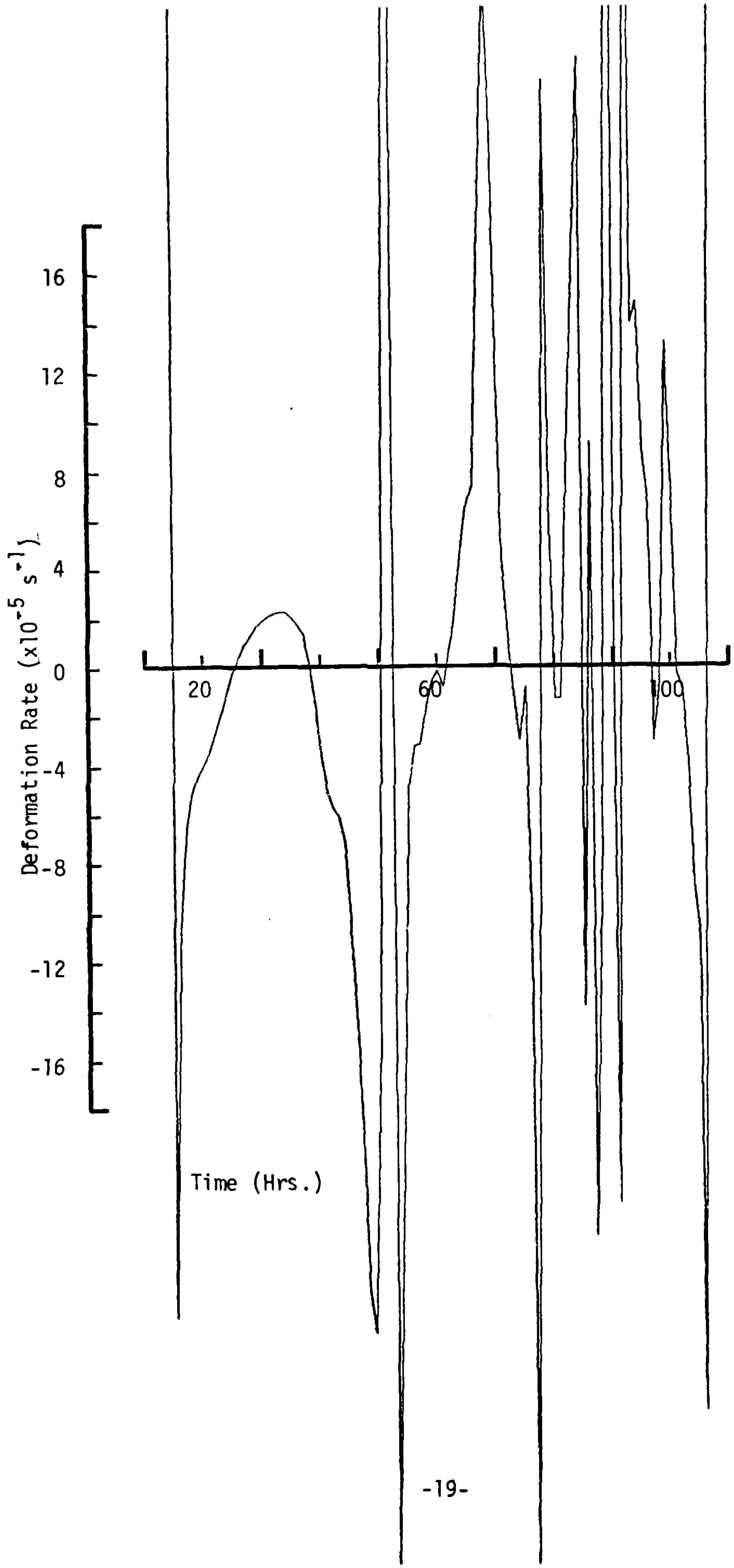
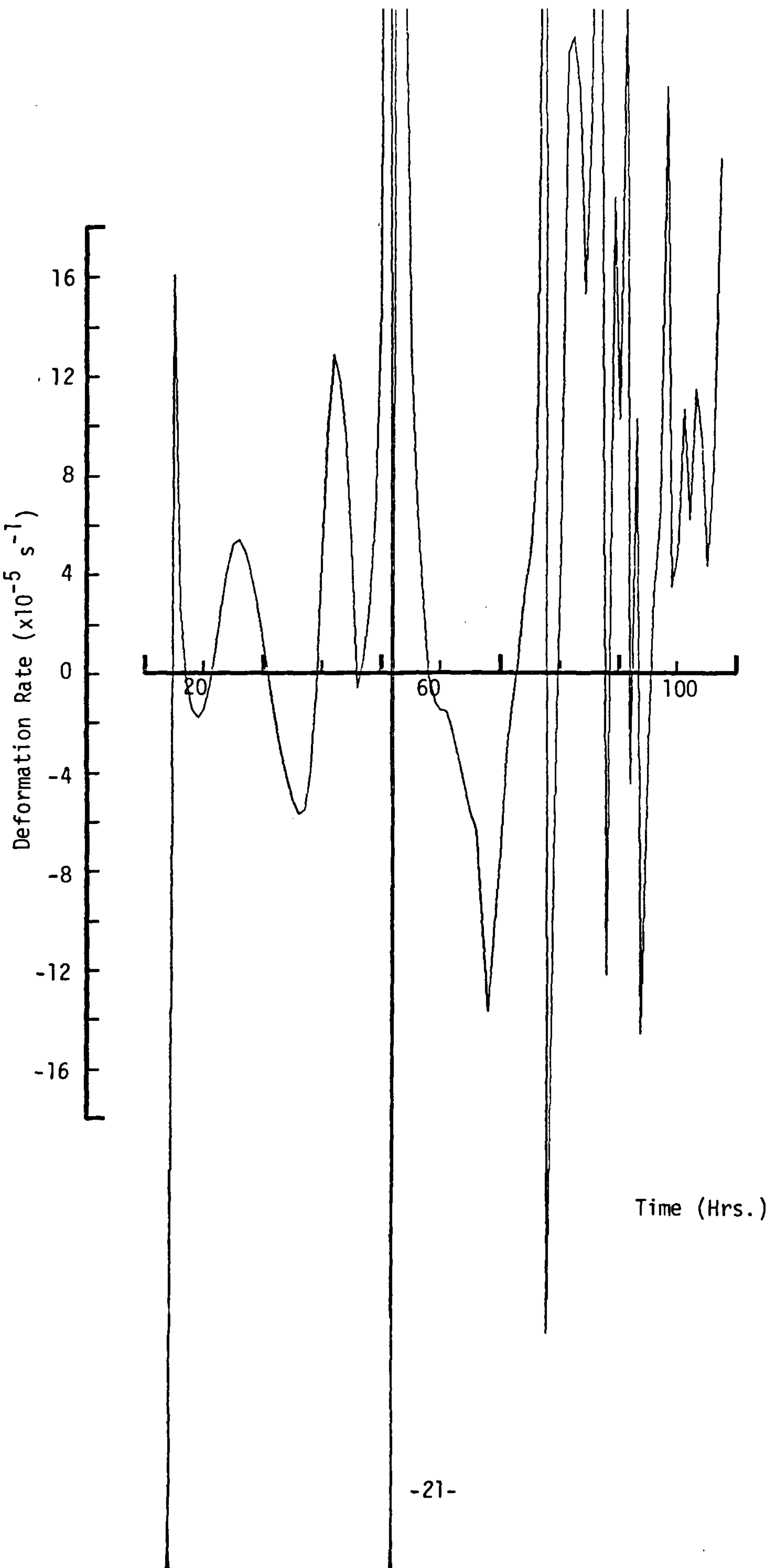
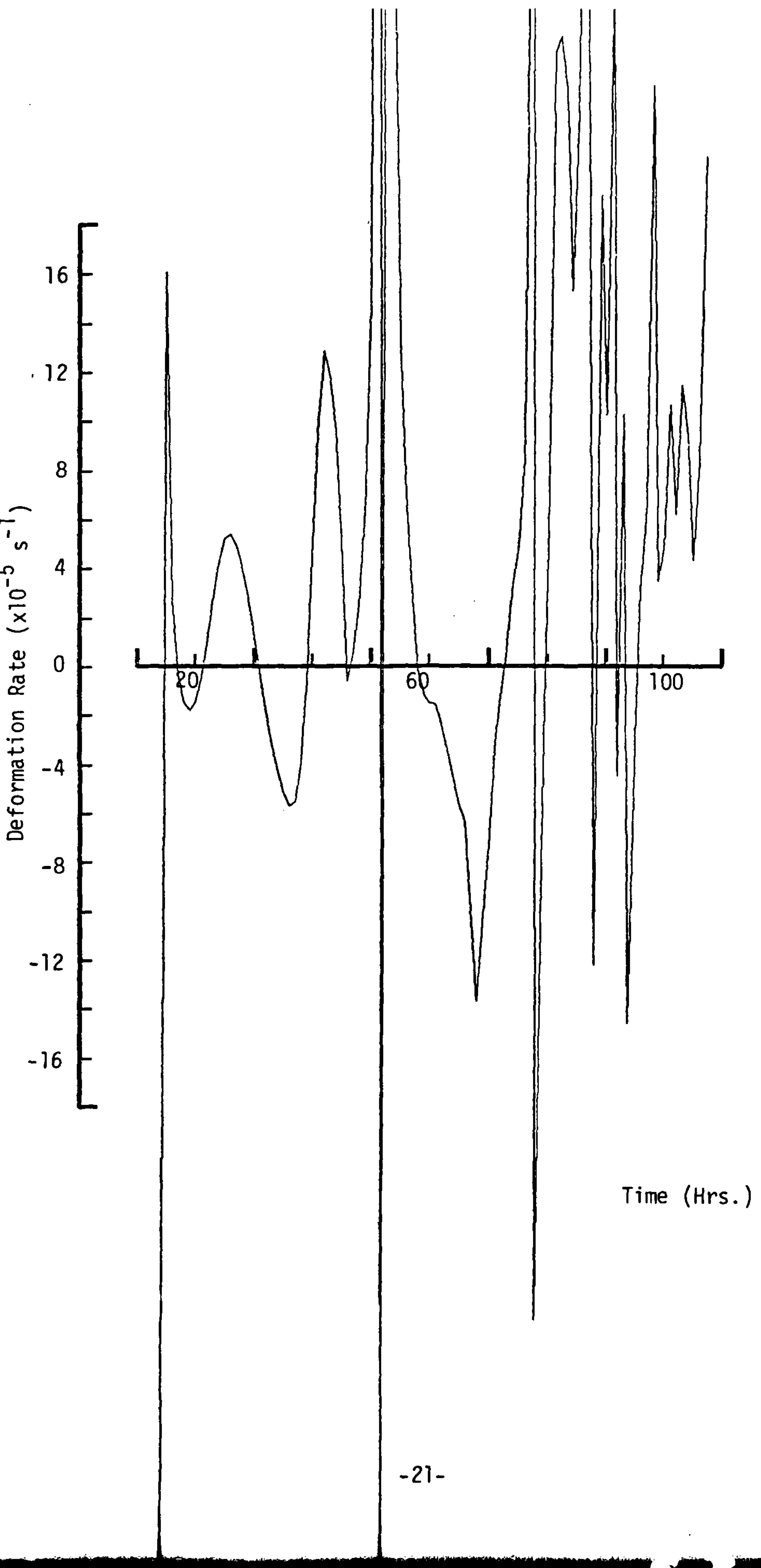

16
12
8
4
0
-4
-8
-12
-16
Deformation Rate (x10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Fig. 6 Normal deformation rates for the small-scale cluster (without corrections for position errors).

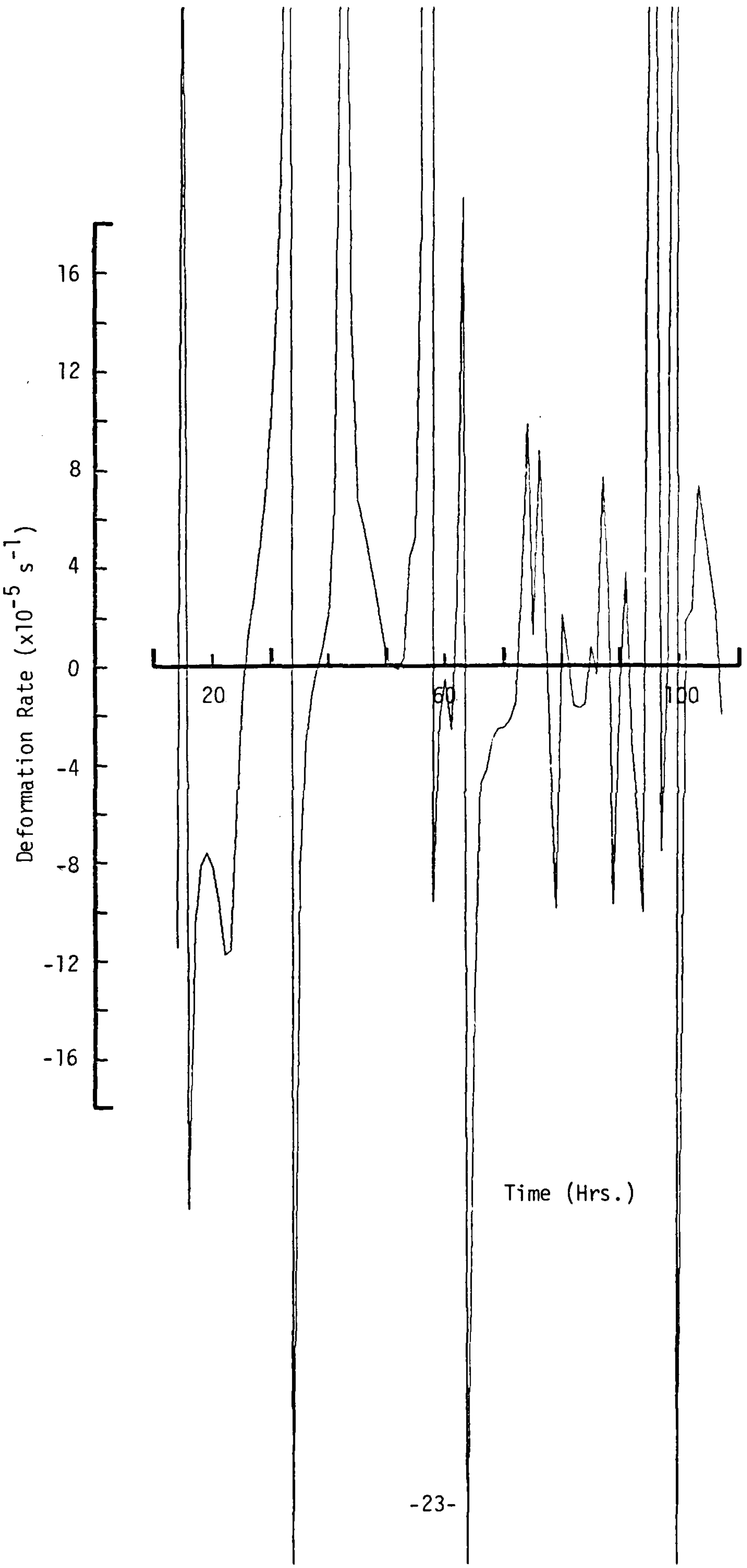

Deformation Rate (x10^{-5} s^{-1})
16
12
8
4
0
-4
-8
-12
-16
20
60
100
Time (Hrs.)



16
12
8
4
0
-4
-8
-12
-16
Deformation Rate ($x10^{-5}$ s^{-1})
20
60
100
Time (Hrs.)

Fig. 7 Shear deformation rates for the small-scale cluster (with corrections for position errors).

Fig. 7 Shear deformation rates for the small-scale cluster (with corrections for position errors).



Deformation Rate (x10^{-5} s^{-1})
16
12
8
4
0
-4
-8
-12
-16
20
60
100
Time (Hrs.)

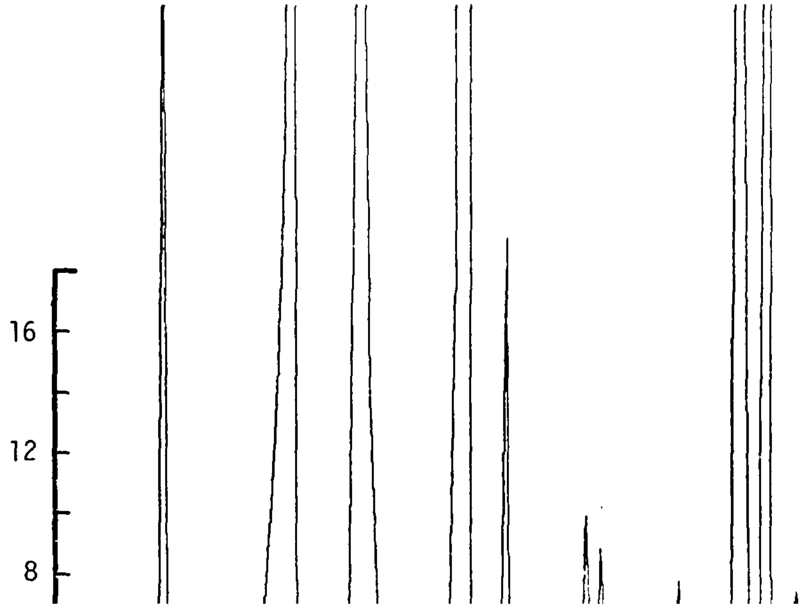

16
12
8

Fig. 8 Normal deformation rates for the small-scale cluster (with corrections for position errors).

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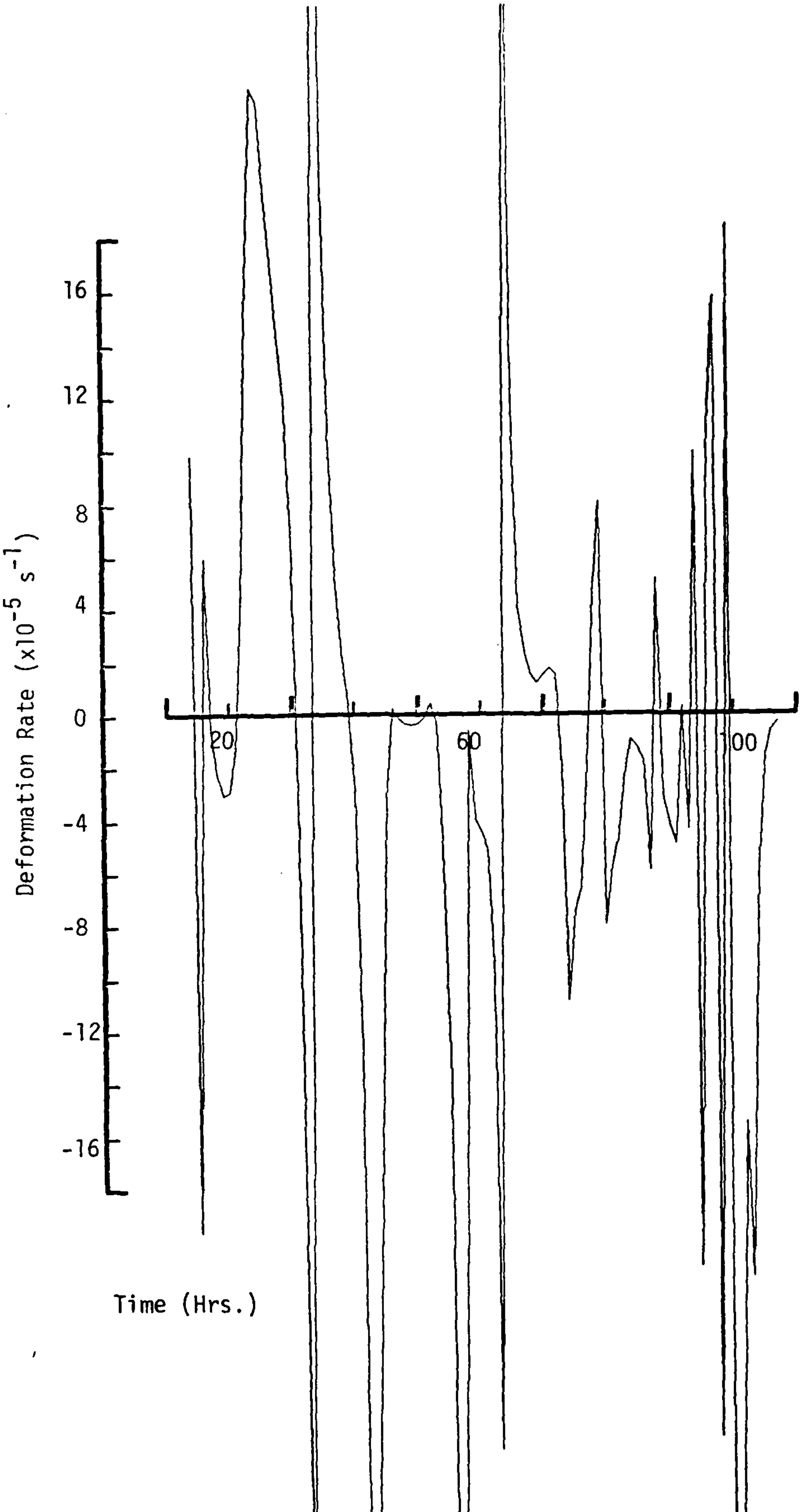
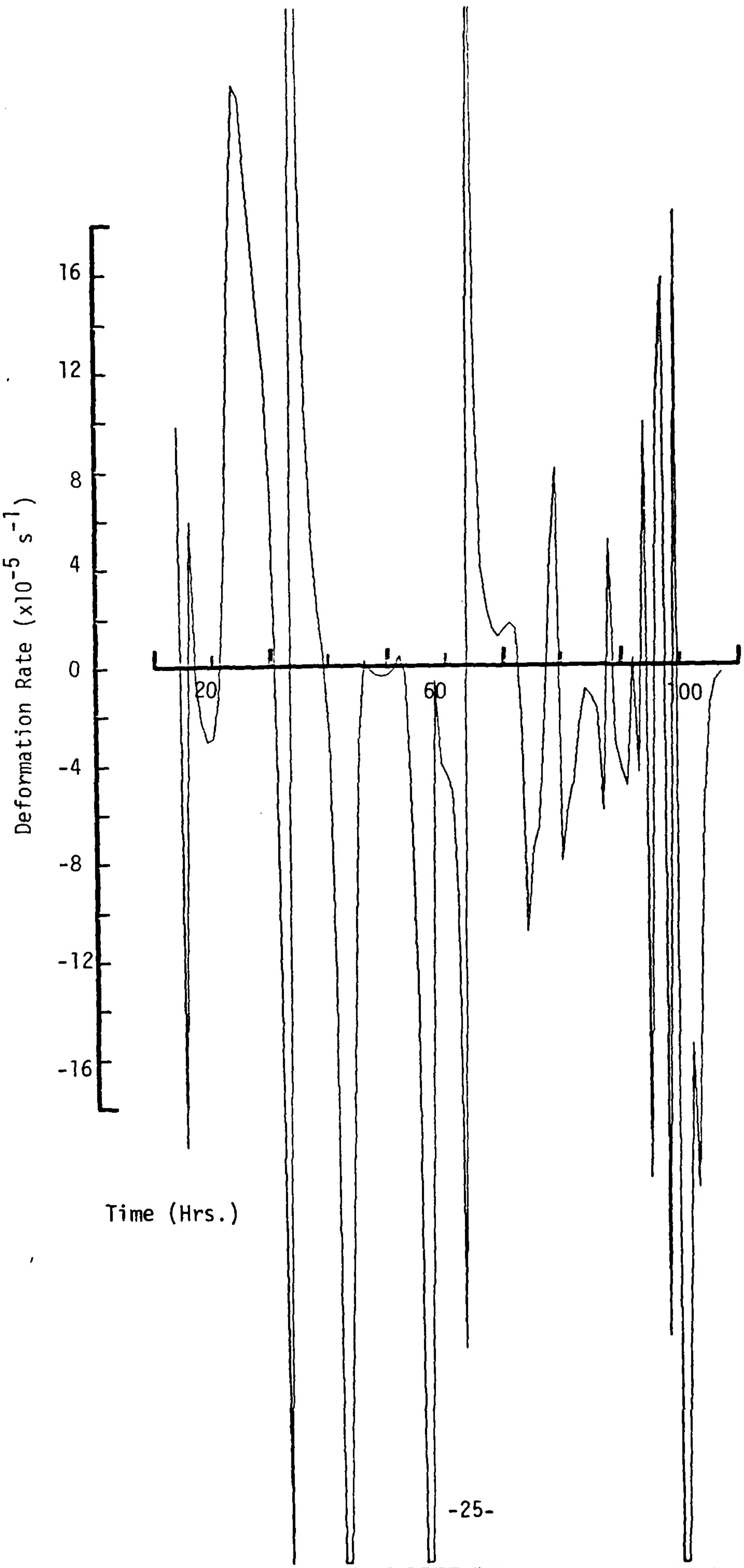

16
12
8
4
0
-4
-8
-12
-16
Deformation Rate (x10^{-5} s^{-1})
20
60
100
Time (Hrs.)


16
12
8
4
0
-4
-8
-12
-16
Deformation Rate (x10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Here f is Coriolis, R represents friction, baroclinic torque and measurement errors. If the right hand side of (11) is smaller than the terms on the left hand side and often changes sign, then we conclude that the mixed layer exhibits a barotropic vorticity balance. This condition provides additional confidence in the data, but the non-existance of this condition is not sufficient evidence that the data is of poor quality.

Fig. 9 shows the time variations of divergence, vorticity, and the three components of the potential vorticity equation. The time derivative term in (11) is the lightest line in Fig. 9c while the second term on the left hand side is the next darker line. The R term in (11) is represented by the darkest line in Fig. 9c.

The time histories of vorticity, divergence, and the potential vorticity components also were calculated with the corrections for position errors. These corrected time histories are shown in Fig. 10.

4.4 Vorticity and Divergence Rates - Small-Scale Cluster

The vorticity and divergence rates were calculated for the small-scale cluster, and the results are shown in Figs. 11 and 12, respectively. The time histories that were corrected for position errors are shown in Figs. 13 (vorticity) and 14 (divergence). As with the shear and normal deformation rates, the values are quite noisy. Also, the position error corrections substantially alter the results.

4.5 Assessment of Interpolation Procedure

Since the interpolation procedure produced approximately 4 times more data than was observed, tests were conducted to determine what effect the interpolation had on the character of the DKP. This was done by repeating the calculations described in sections 4.1 through 4.4 but taking only every fourth data point.

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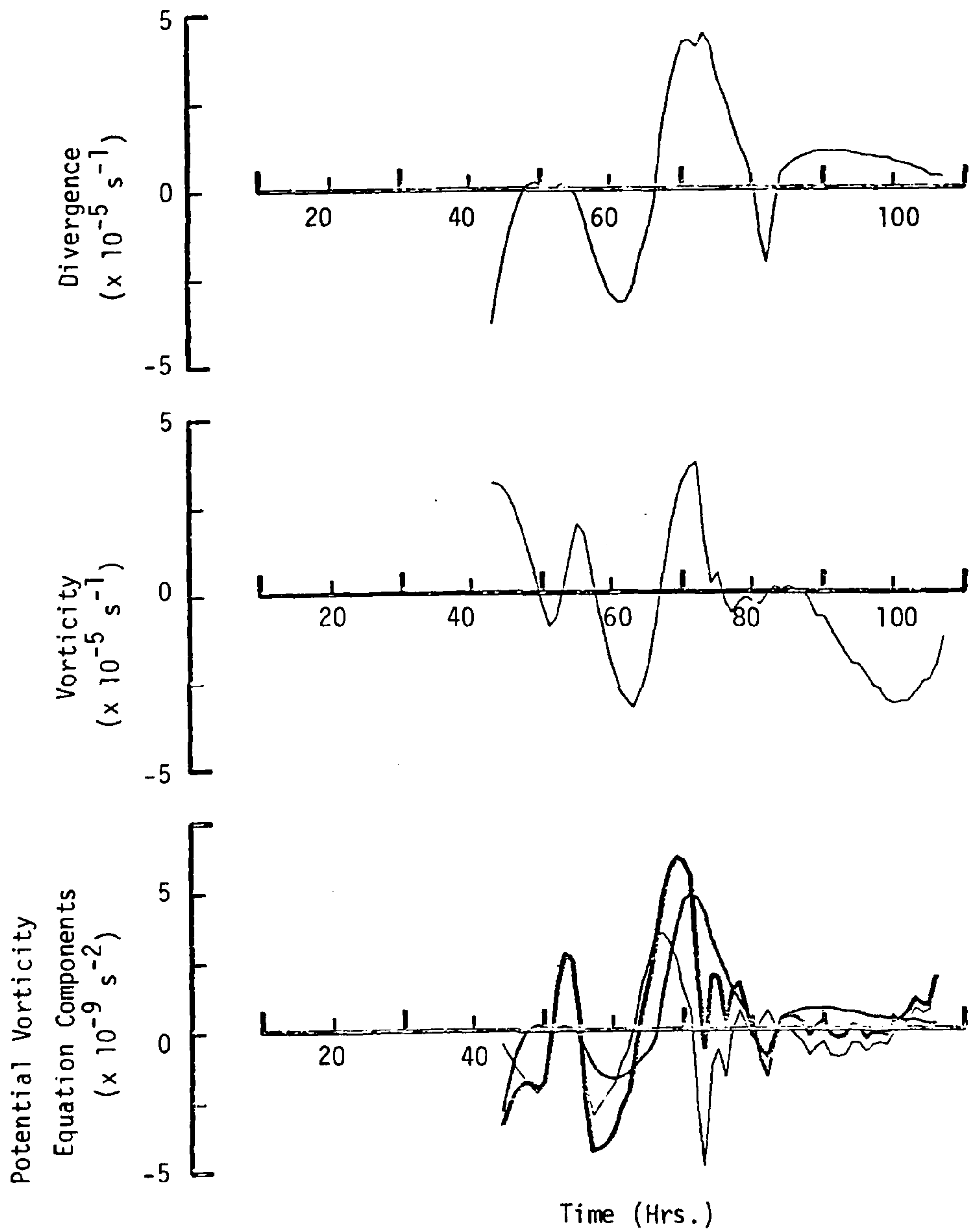
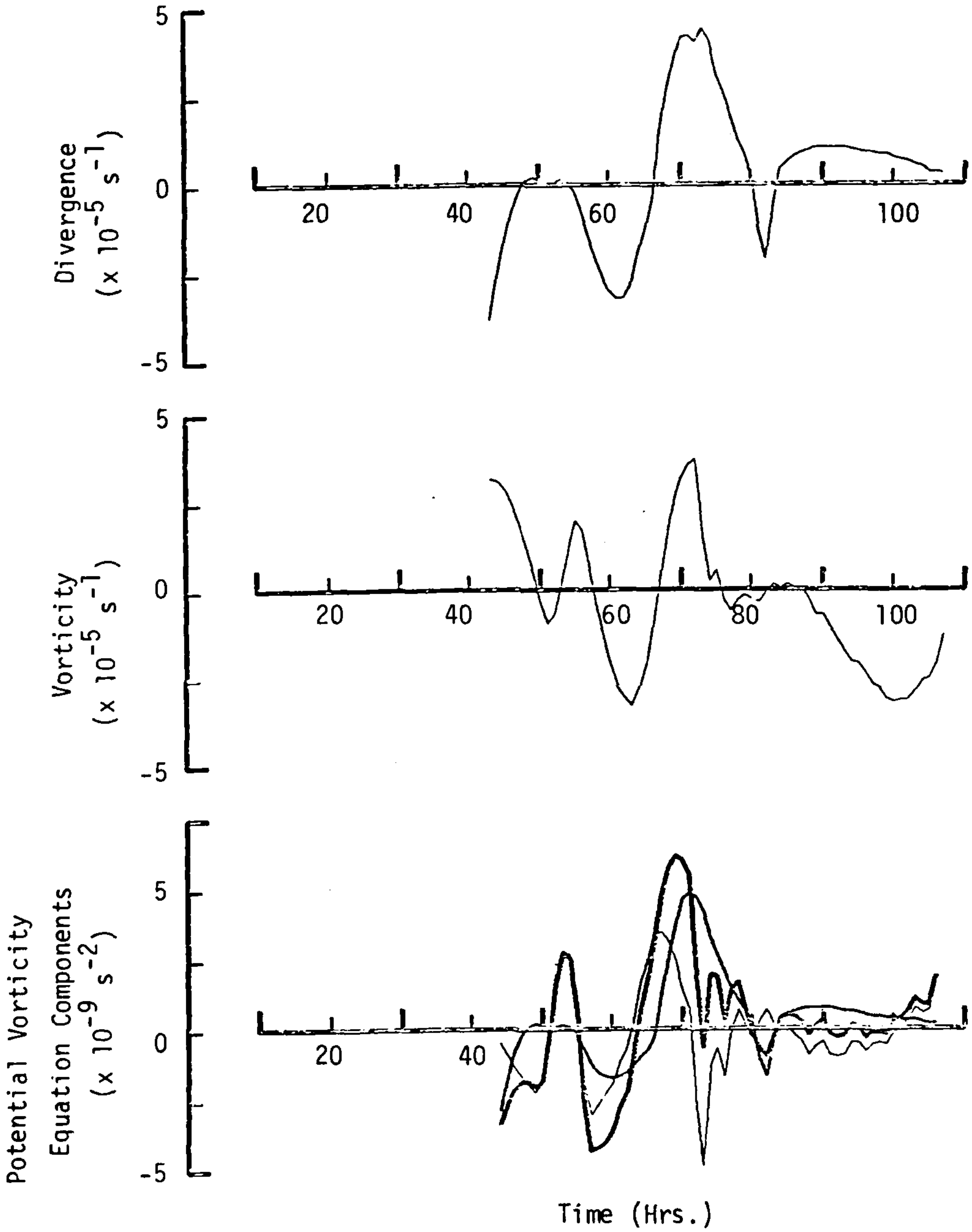


Fig. 9 Divergence, vorticity, and the potential vorticity equation components for the large-scale cluster (without corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.



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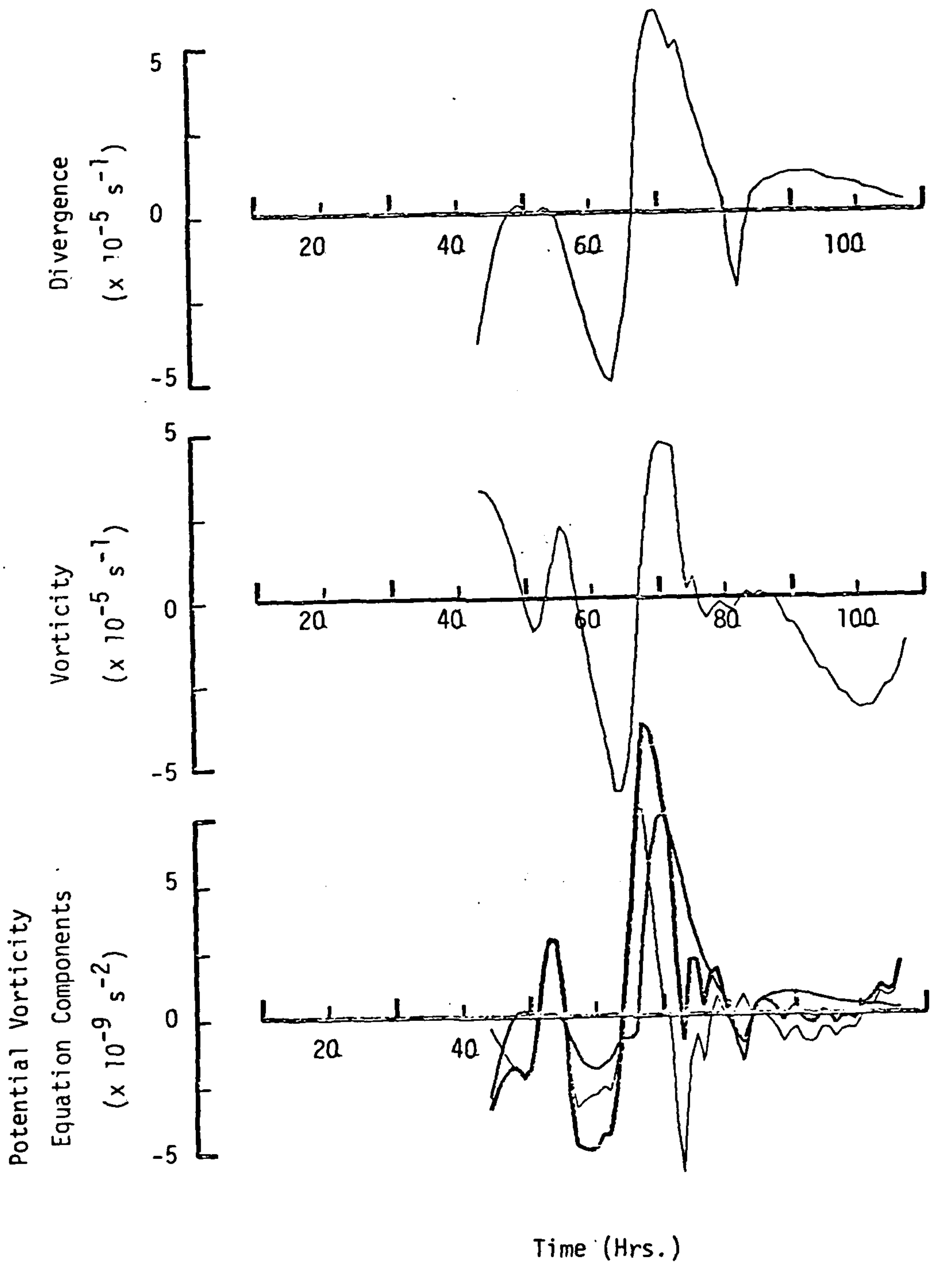

Fig. 10 Divergence, vorticity, and the potential vorticity equation components for the large-scale cluster (with corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.

Fig. 11 Vorticity for the small-scale cluster (without corrections for position errors).

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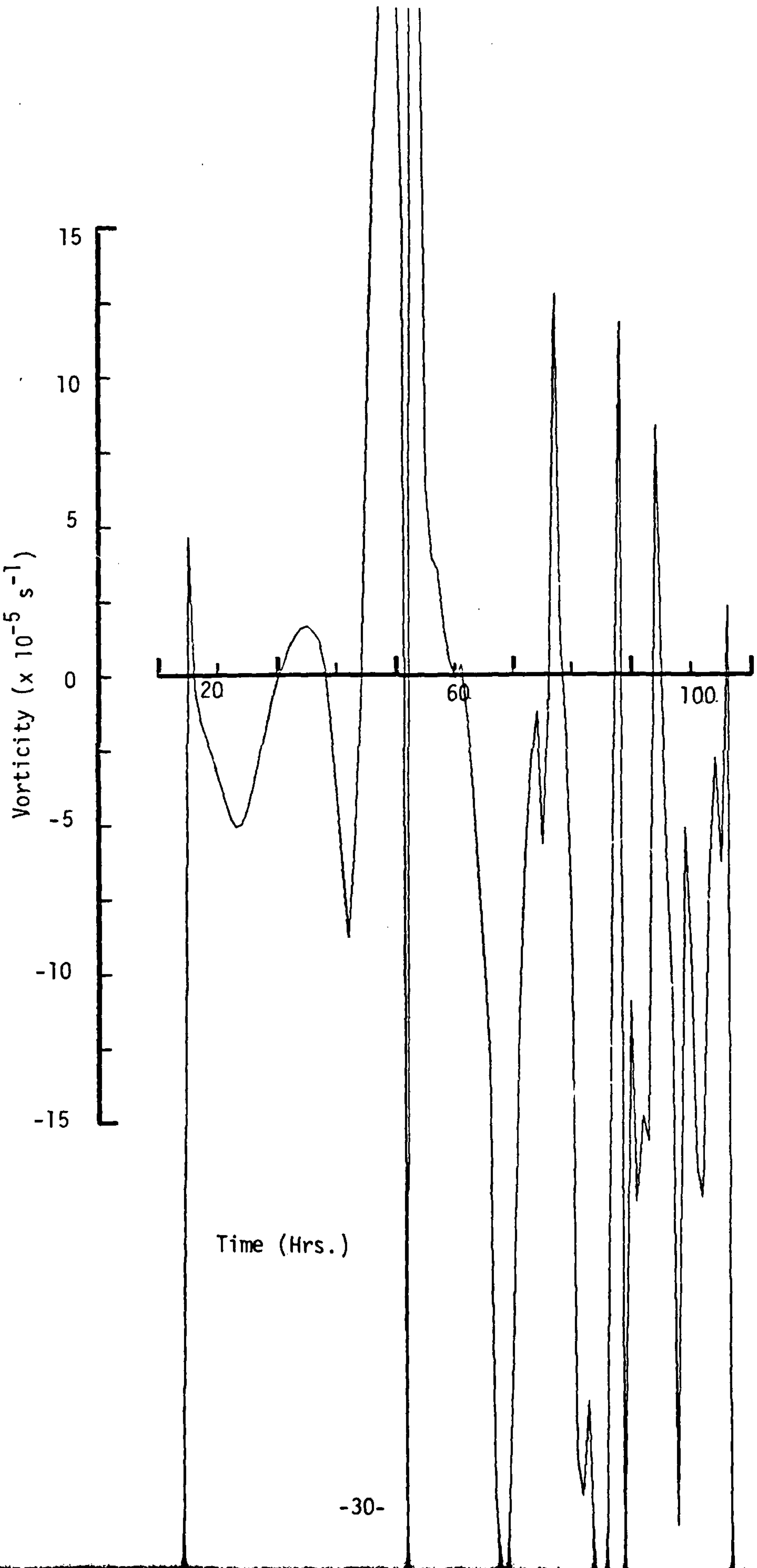
15
10
5
0
-5
-10
-15
Vorticity (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Fig. 12 Divergence for the small-scale cluster (without corrections for position errors).

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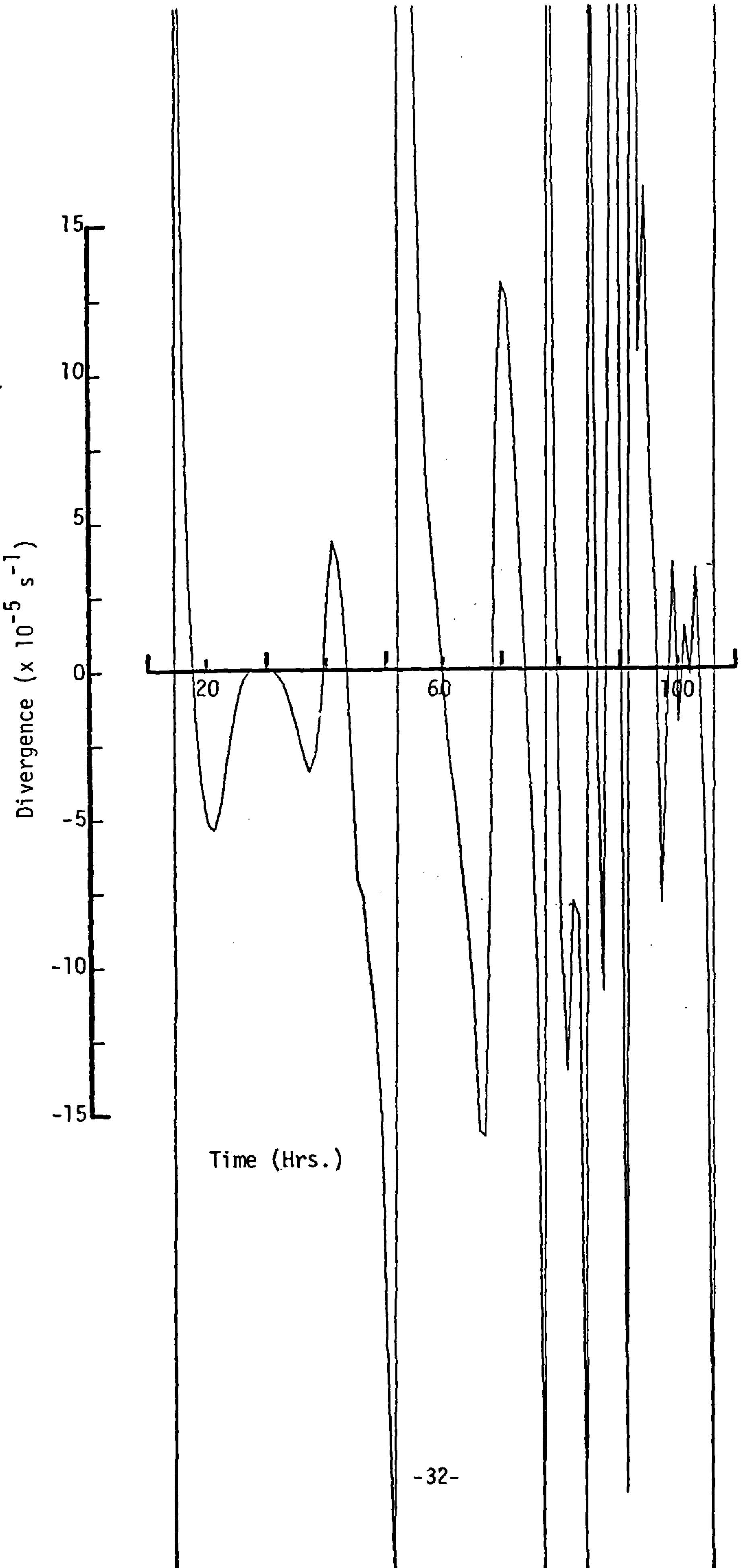
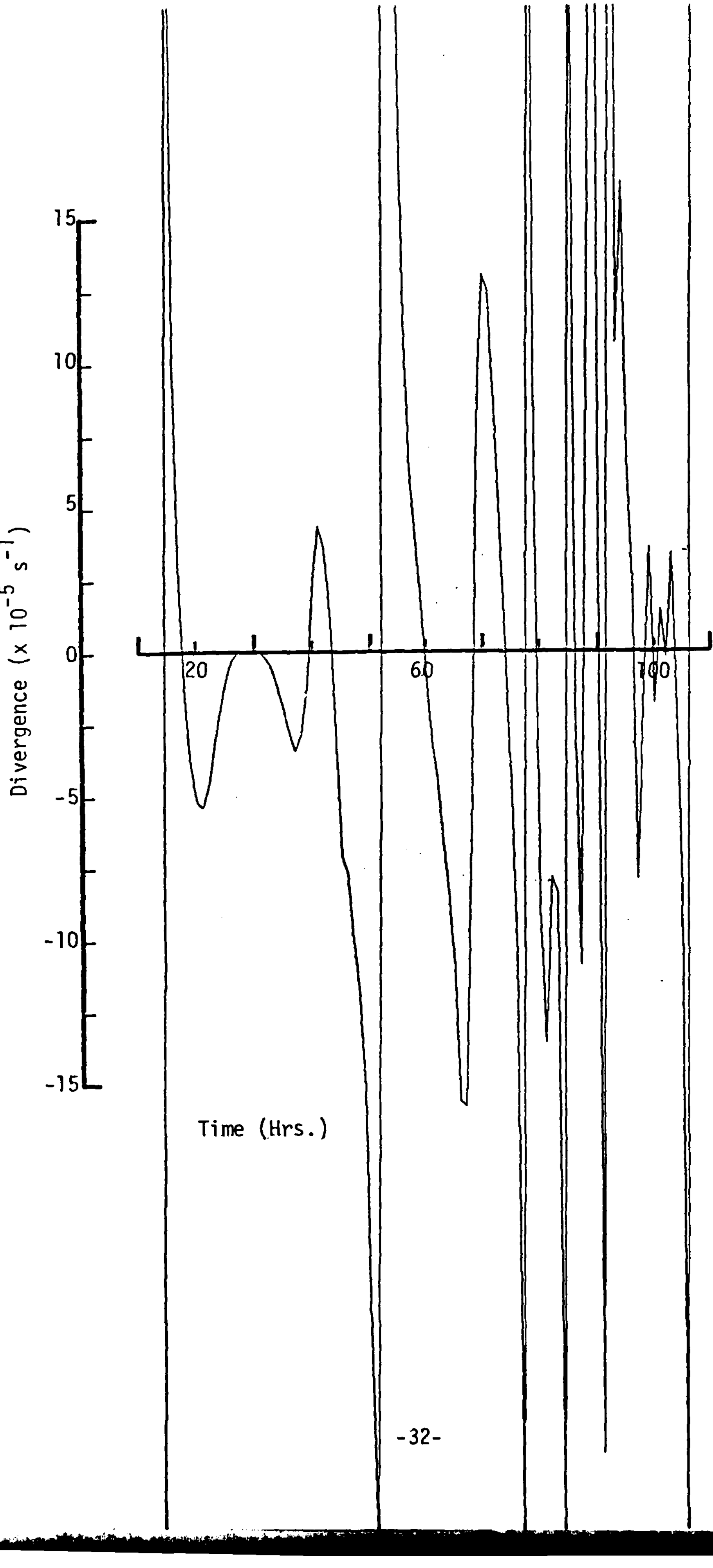

15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)



15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Fig. 13 Vorticity for the small-scale cluster (with corrections for position errors).

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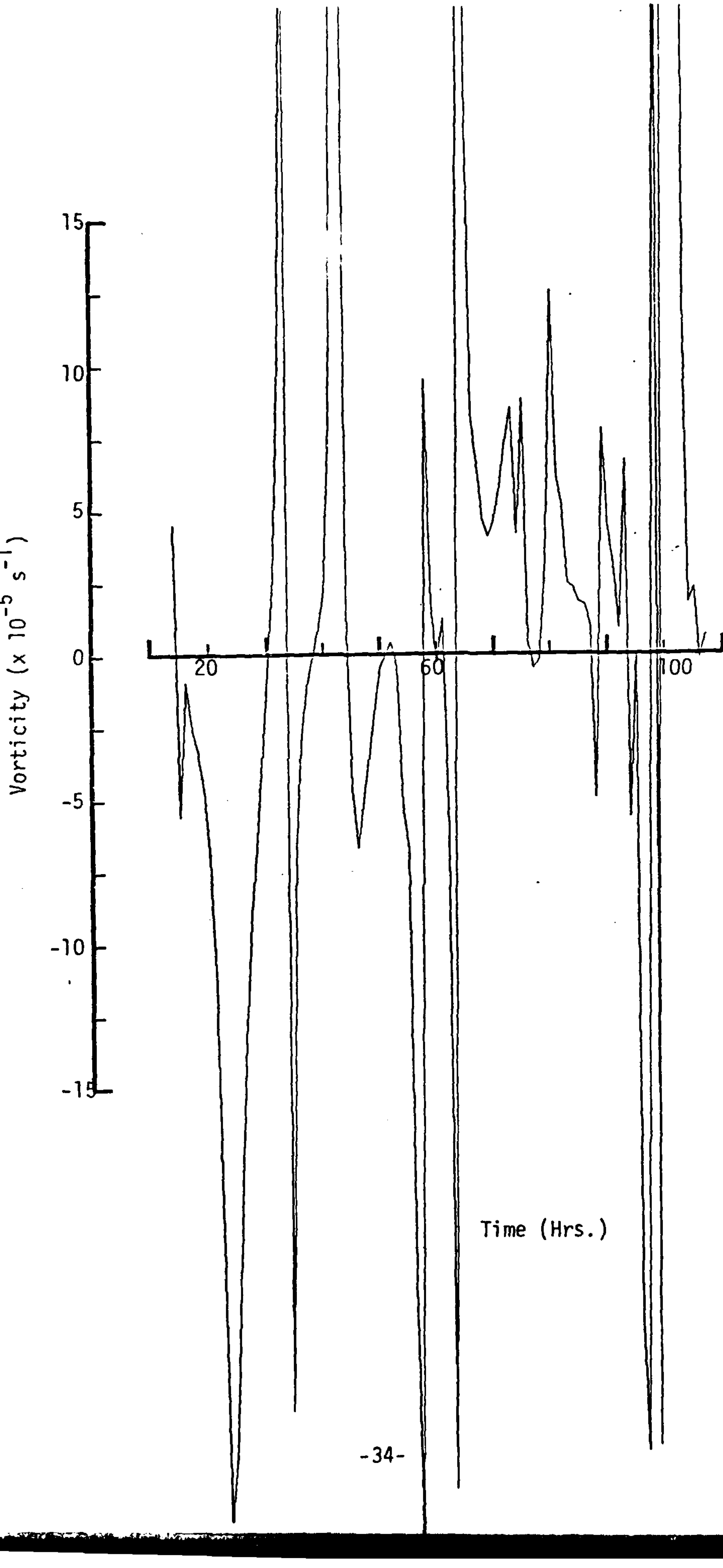


15
10
5
0
-5
-10
-15
Vorticity (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

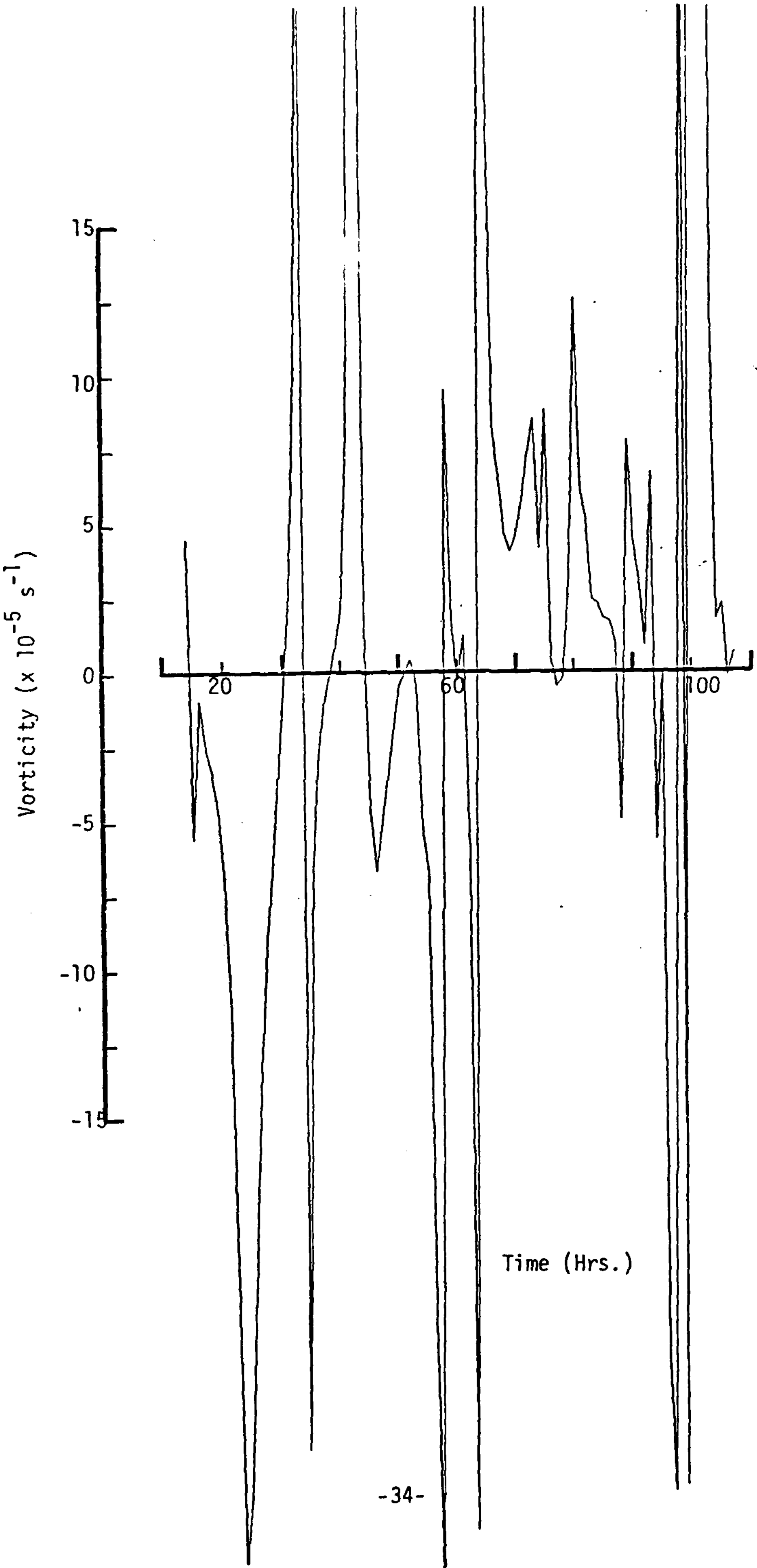
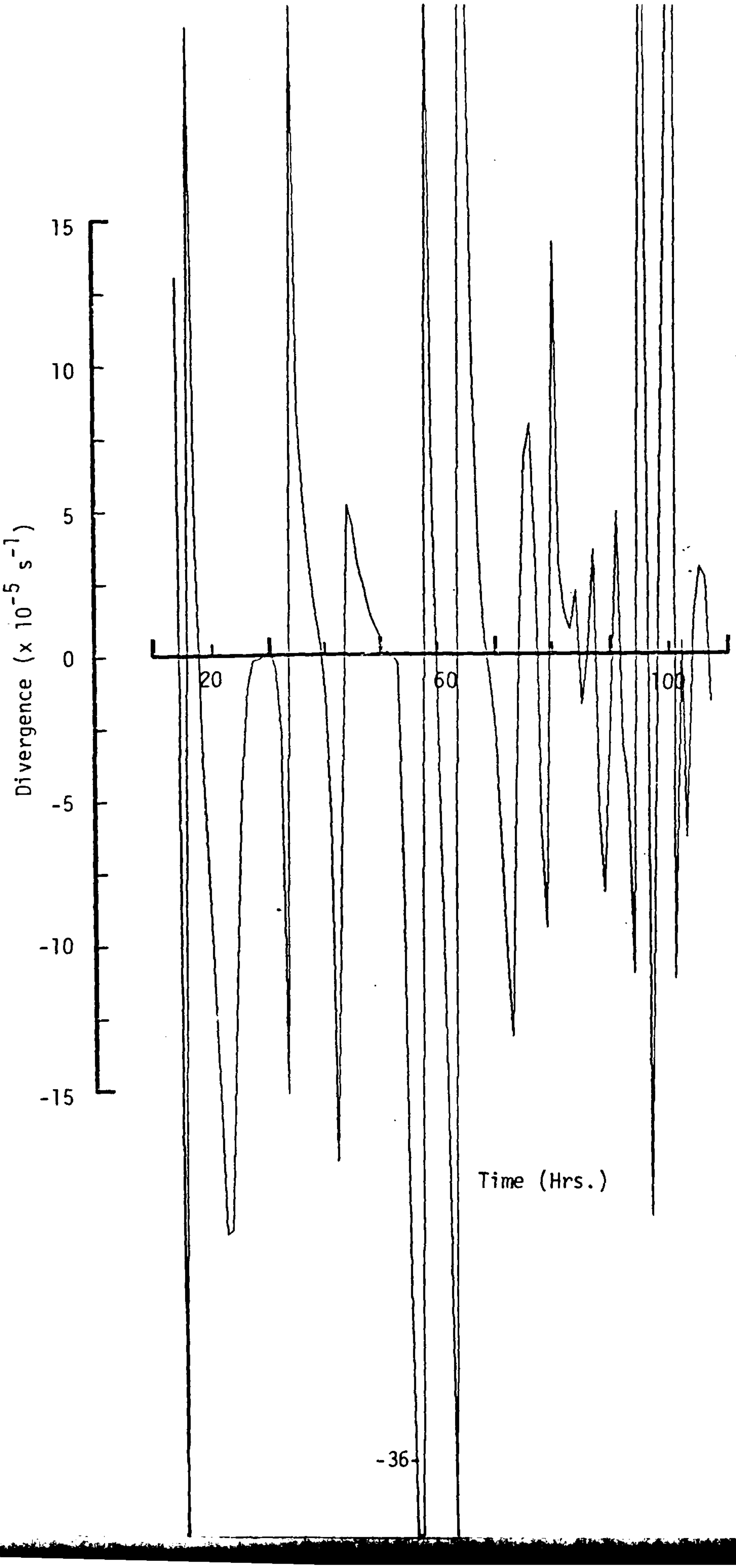
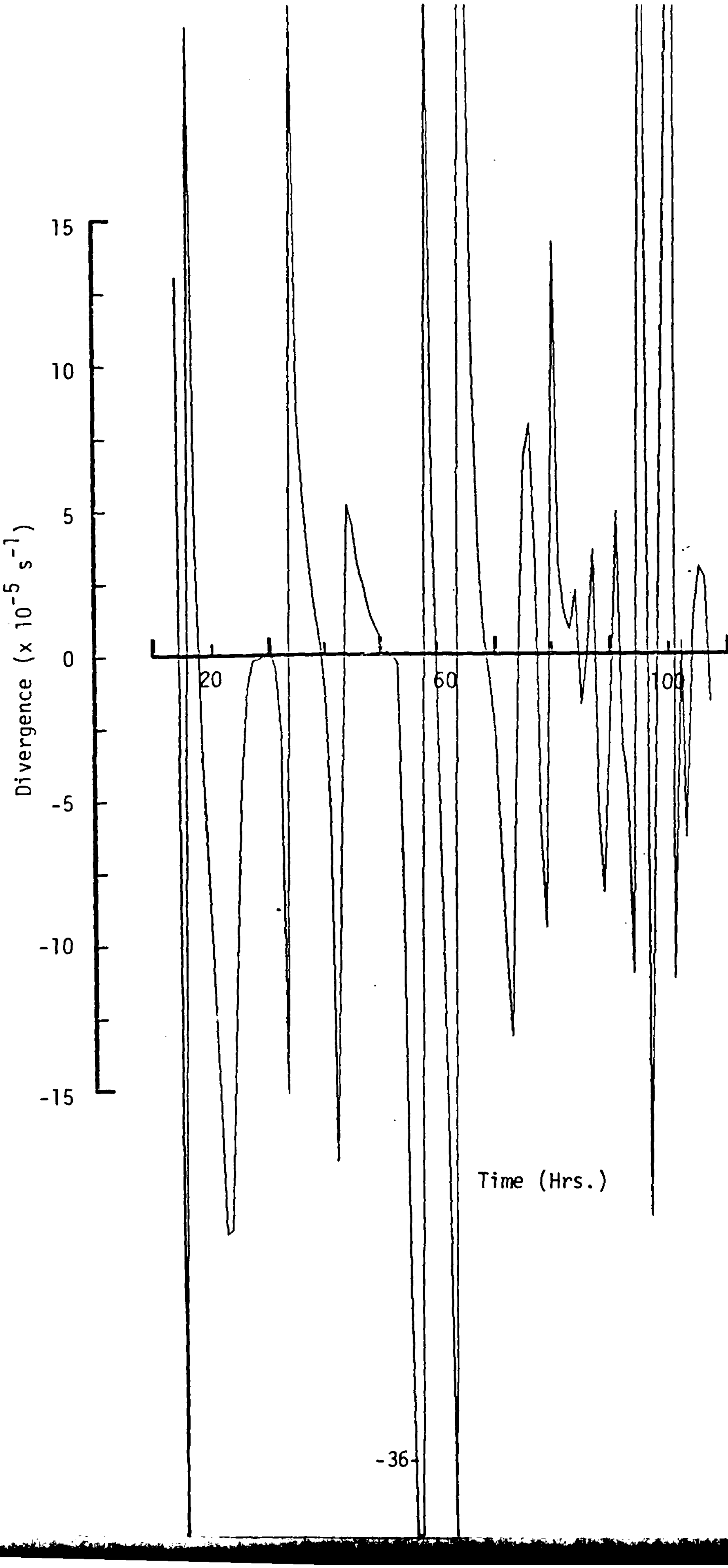

15
10
5
0
-5
-10
-15
Vorticity ($\times 10^{-5}$ s^{-1})
20
60
100
Time (Hrs.)

Fig. 14 Divergence for the small-scale cluster (with corrections for position errors).

Fig. 14 Divergence for the small-scale cluster (with corrections for position errors).



15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)



15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

The shear and normal deformation rates for the large-scale cluster were recalculated for both coordinate systems. These time histories are shown in Figs. 15 and 16, respectively. The time histories that were corrected for position errors are shown in Figs. 17 and 18.

The shear and normal deformation rates were recalculated for the small-scale cluster, and these time histories are shown in Figs. 19 and 20, respectively. The time histories corrected for position error are shown in Figs. 21 and 22.

The vorticity and divergence rates for the large-scale cluster were recalculated, and these time histories are shown in Fig. 23. Also shown in Fig. 23 are the components of the vorticity equation. Fig. 24 shows the same time histories but with the position error correction.

The vorticity and divergence rates for the small-scale cluster were recalculated using every 4th point, and these time histories are shown in Figs. 25 and 26, respectively. These time histories after being corrected for position error are shown in Figs. 27 and 28.

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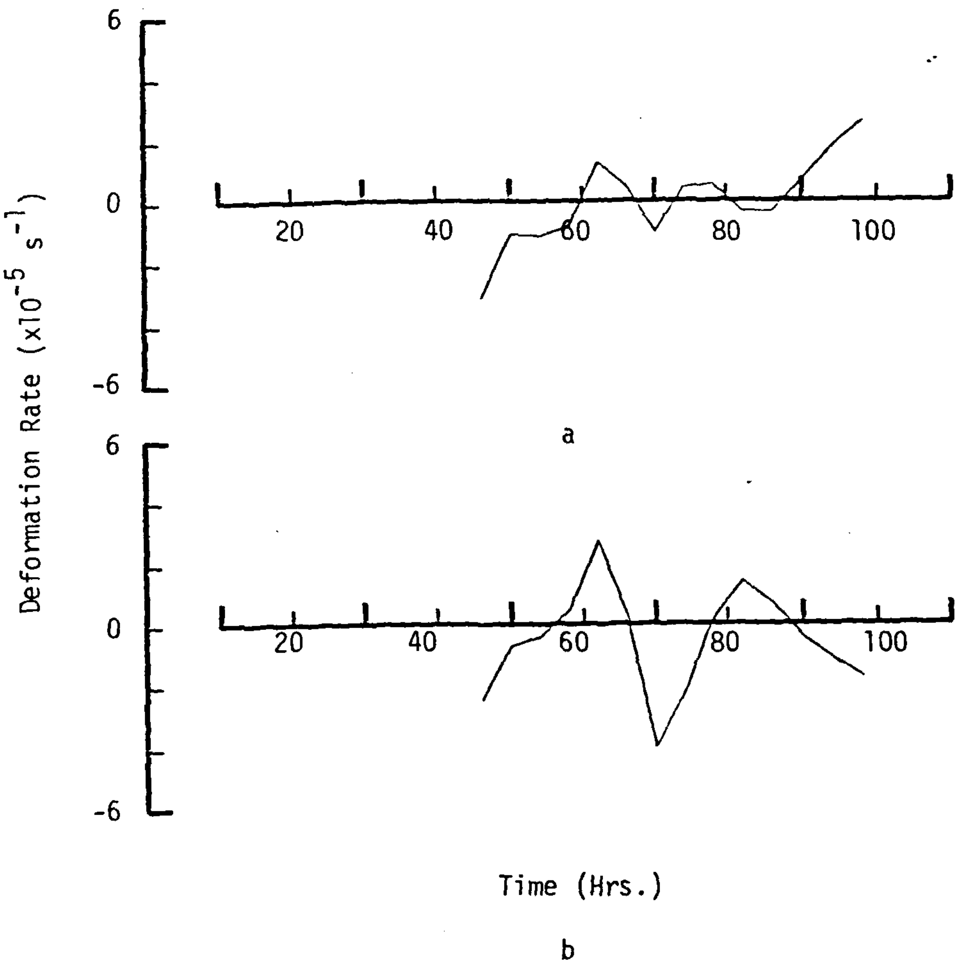
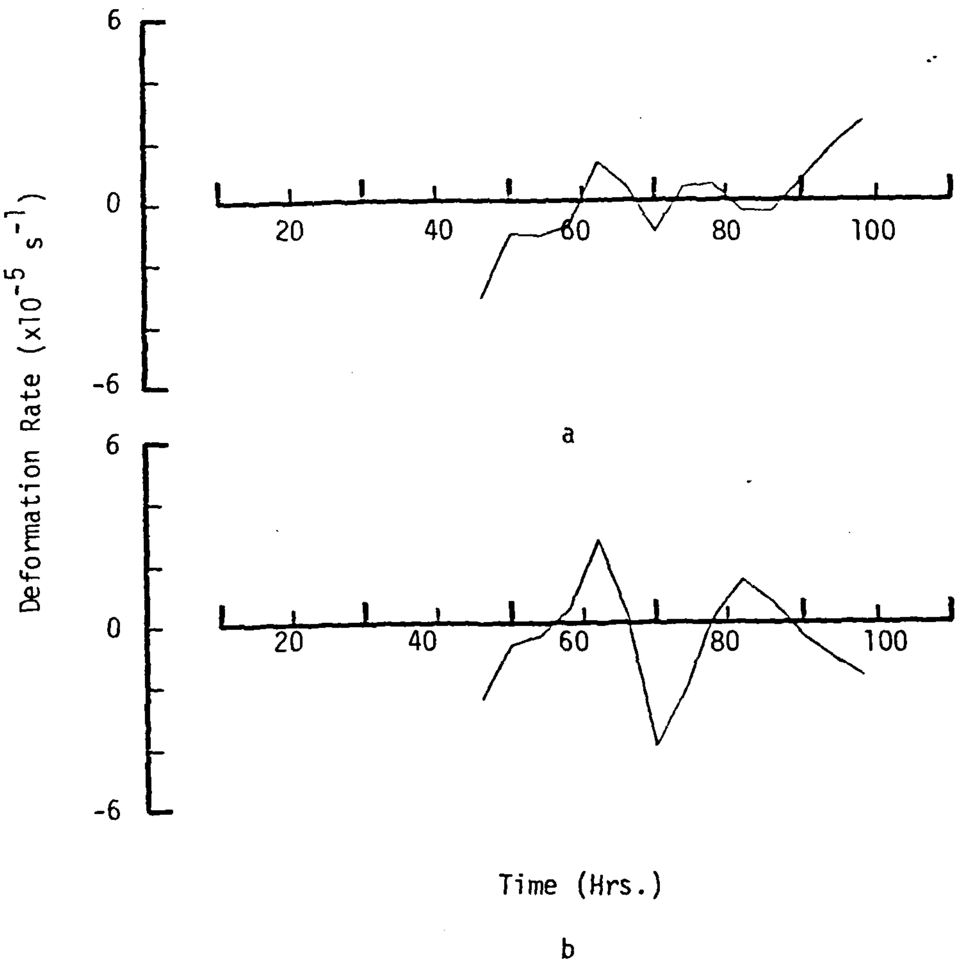


Fig. 15 Shear deformation rates for the large-scale cluster using every 4th data point (without corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.



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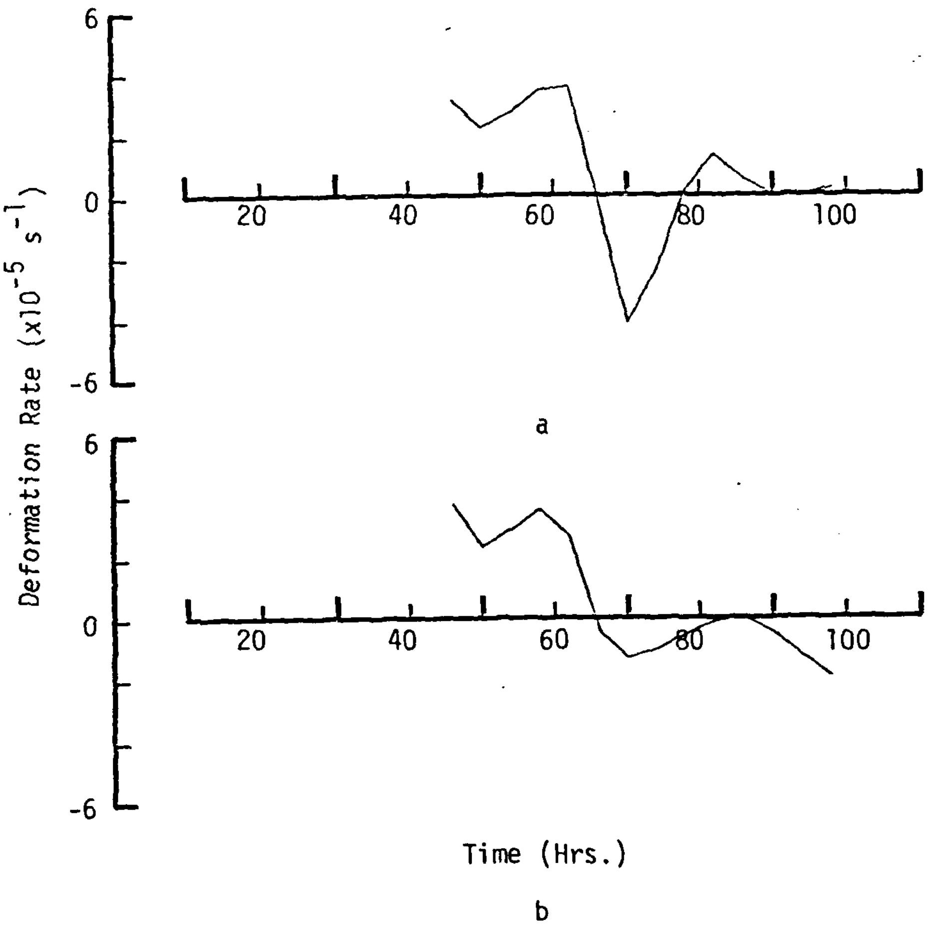
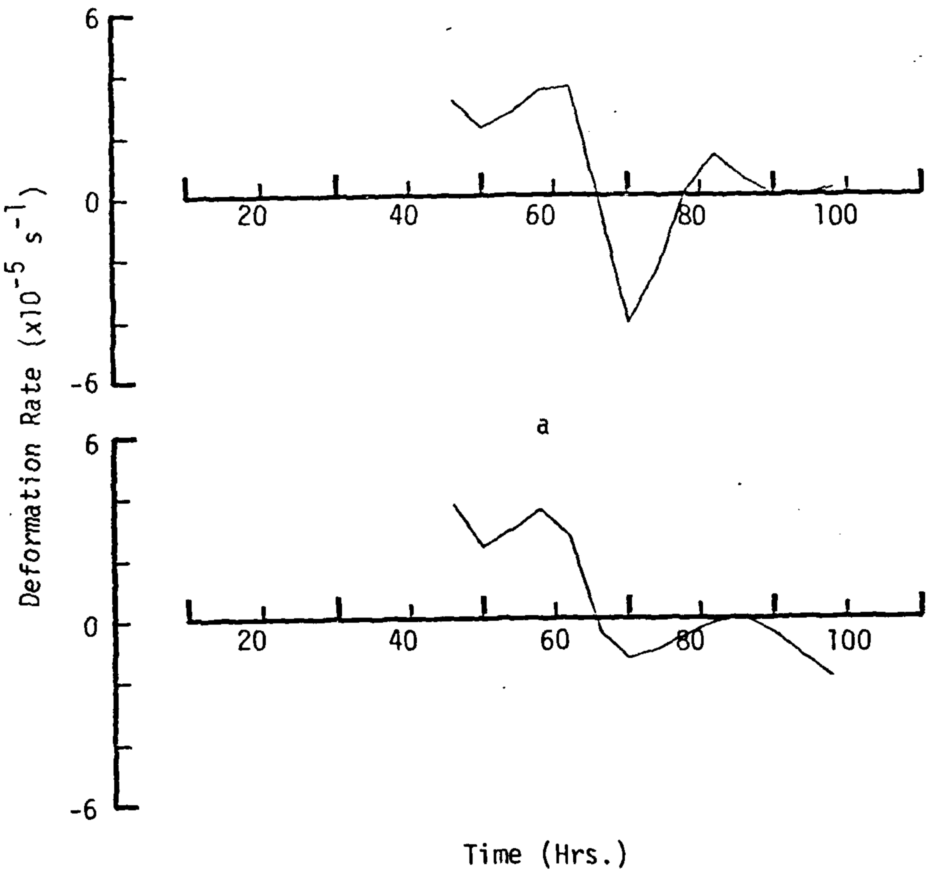


Fig. 16 Normal deformation rates for the large-scale cluster using every 4th data point (without corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.



b

Fig. 16 Normal deformation rates for the large-scale cluster using every 4th data point (without corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.

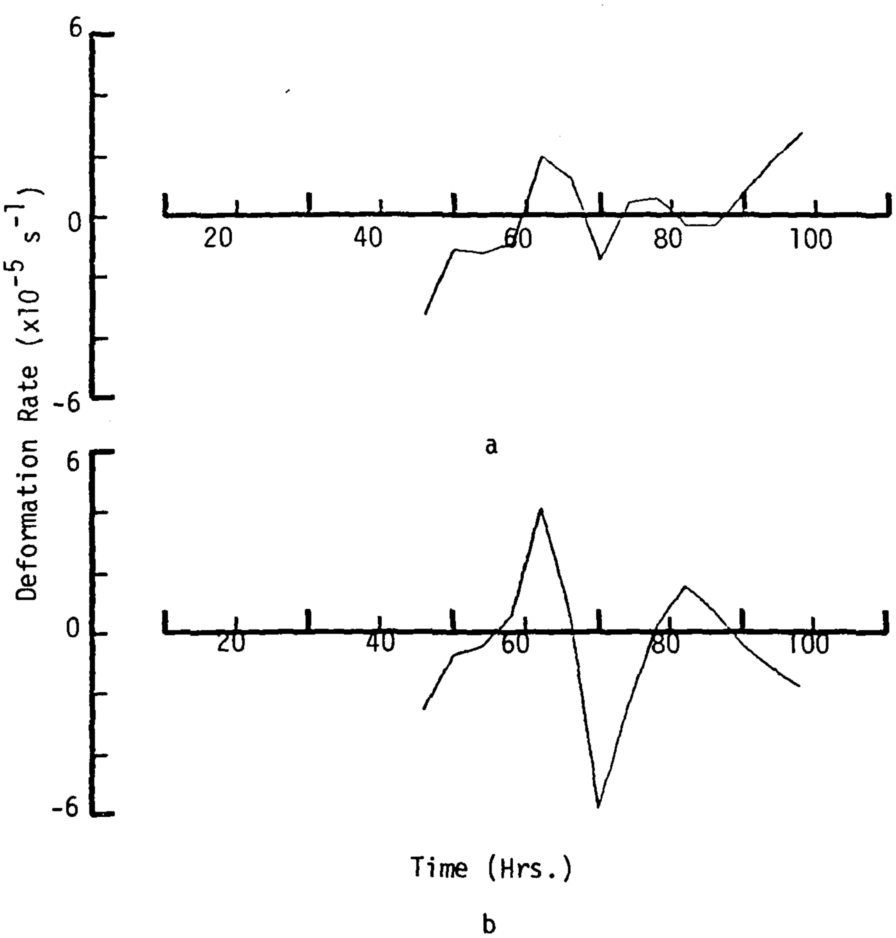


Fig. 17 Shear deformation rates for the large-scale cluster using every 4th data point (with corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.

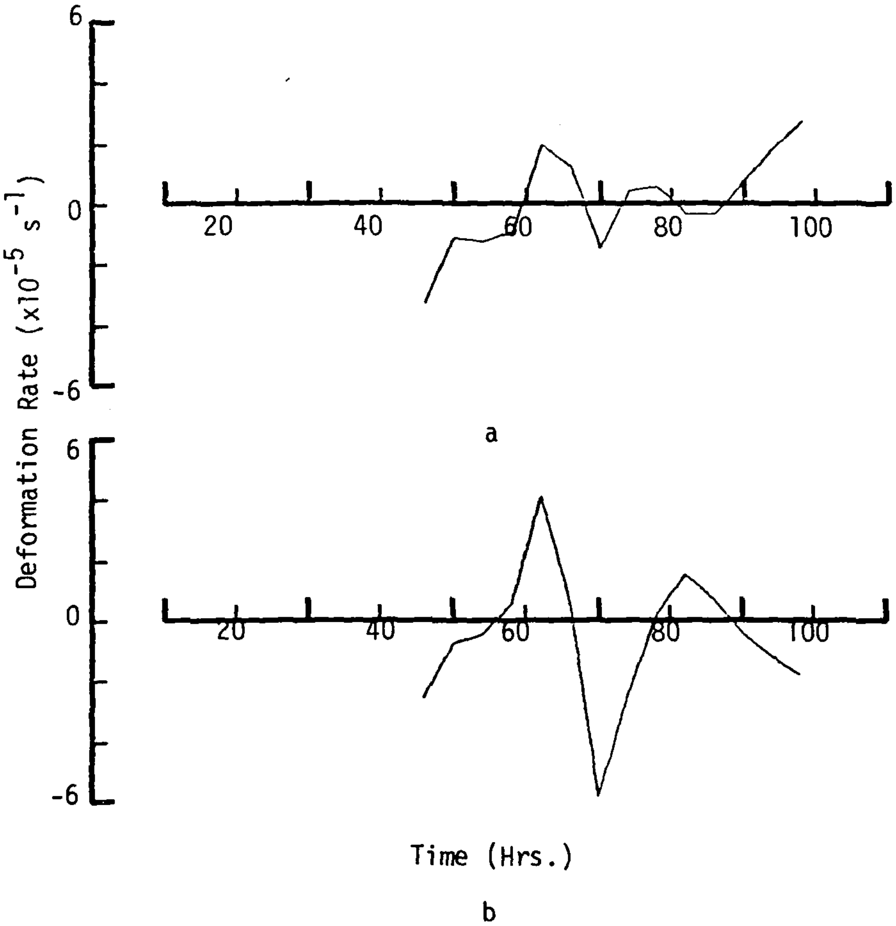


Fig. 17 Shear deformation rates for the large-scale cluster using every 4th data point (with corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.

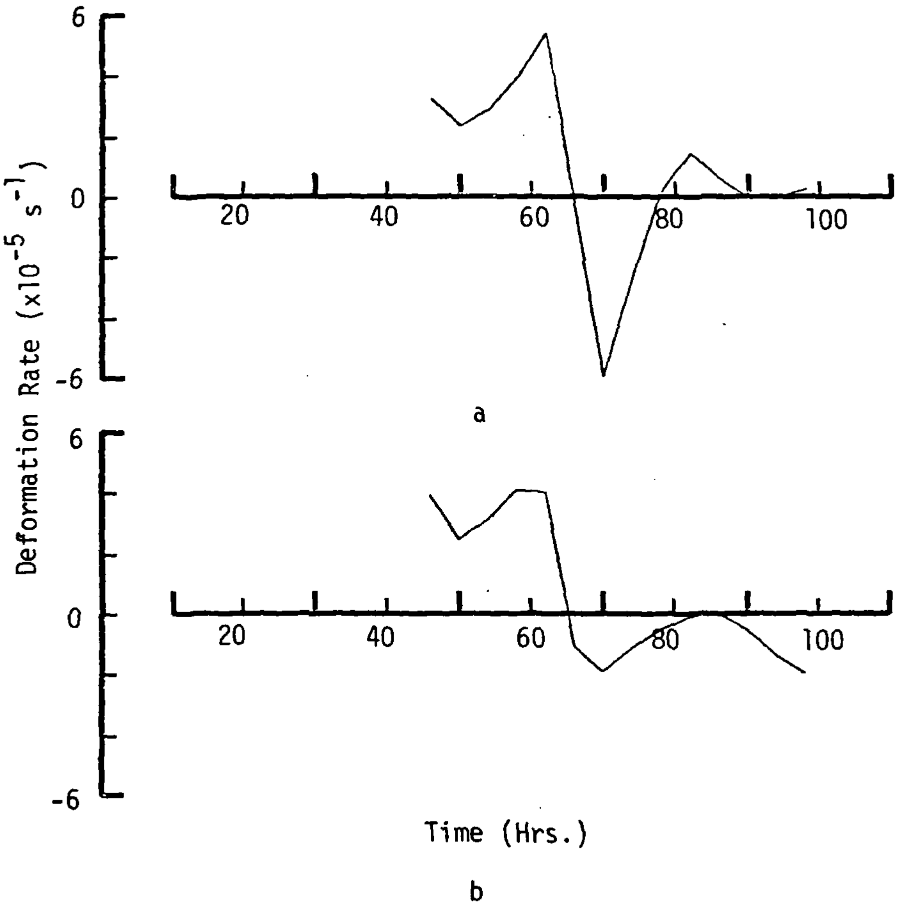
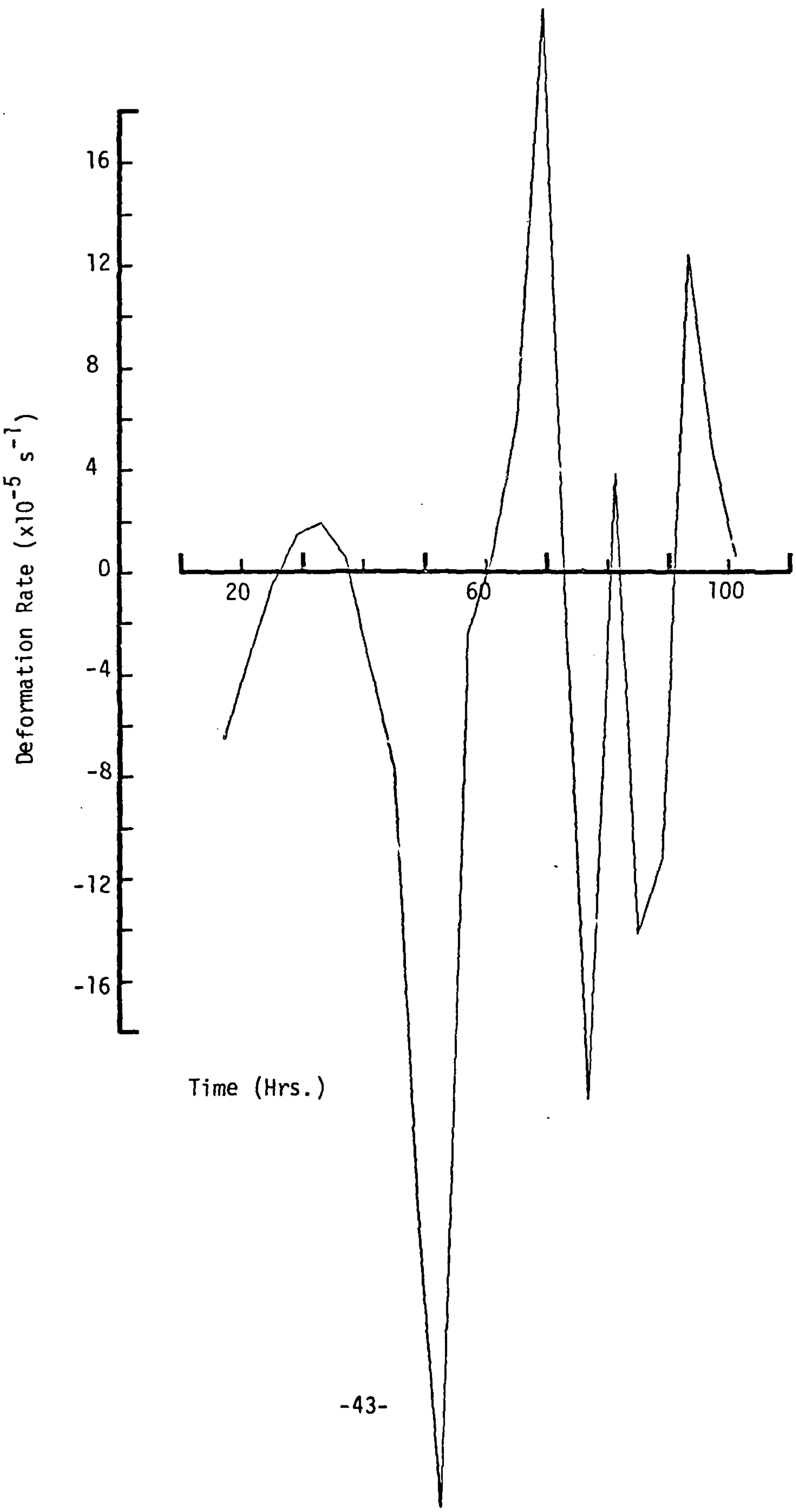


Fig. 18 Normal deformation rates for the large-scale cluster using every 4th data point (with corrections for position errors). a is for a geographic coordinate system, and b is for a natural coordinate system.

Fig. 19 Shear deformation rates for the small-scale cluster using every 4th data point (without corrections for position errors).


16
12
8
4
0
-4
-8
-12
-16
Deformation Rate (x10^{-5} s^{-1})
20
60
100
Time (Hrs.)

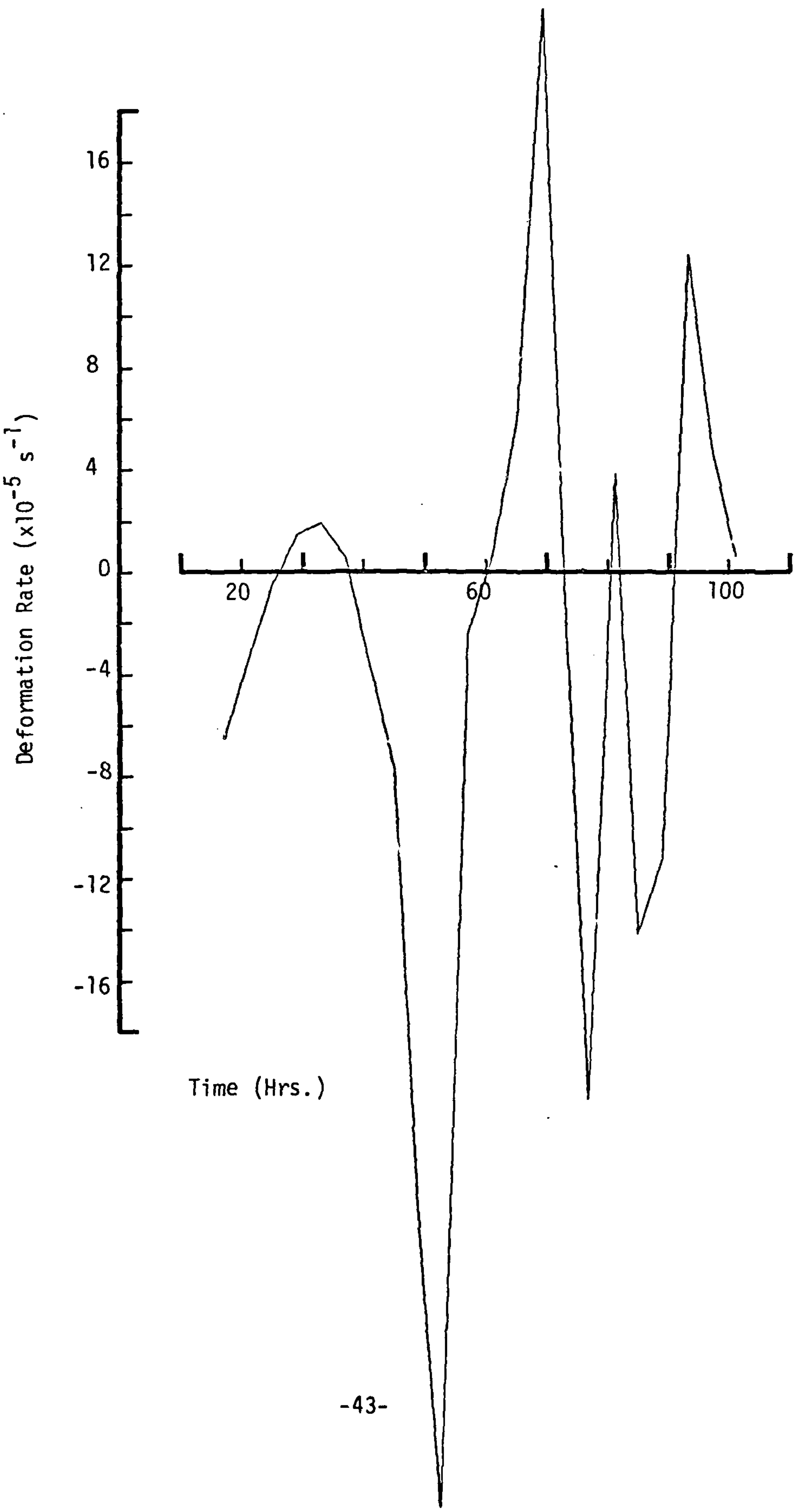
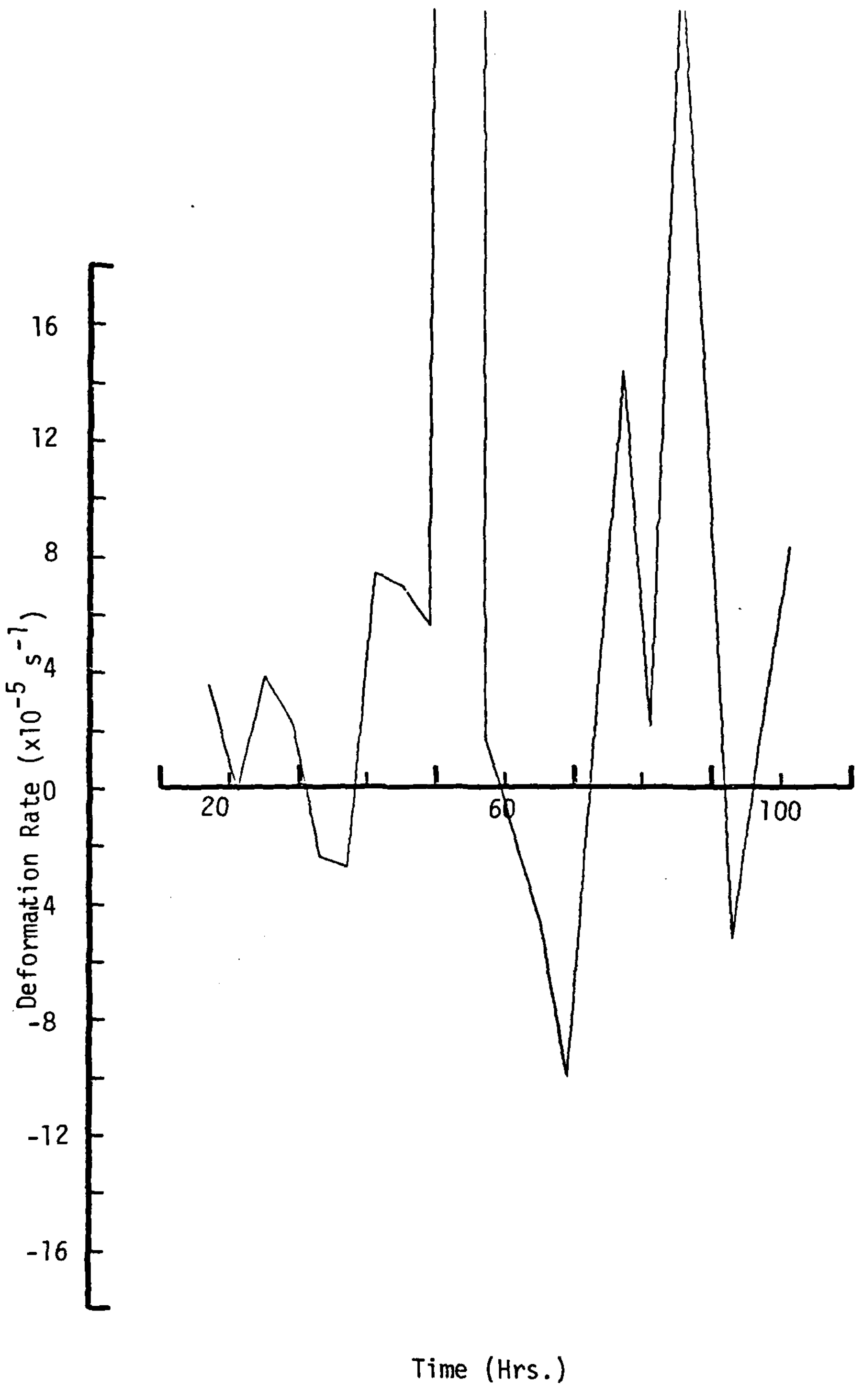

16
12
8
4
0
-4
-8
-12
-16
Deformation Rate ($\times 10^{-5}$ s^{-1})
20
60
100
Time (Hrs.)

Fig. 20 Normal deformation rates for the small-scale cluster using every 4th data point (without corrections for position errors).

Fig. 20 Normal deformation rates for the small-scale cluster using every 4th data point (without corrections for position errors).


16
12
8
4
0
-4
-8
-12
-16
Deformation Rate ($x10^{-5}s^{-1}$)
20
60
100
Time (Hrs.)

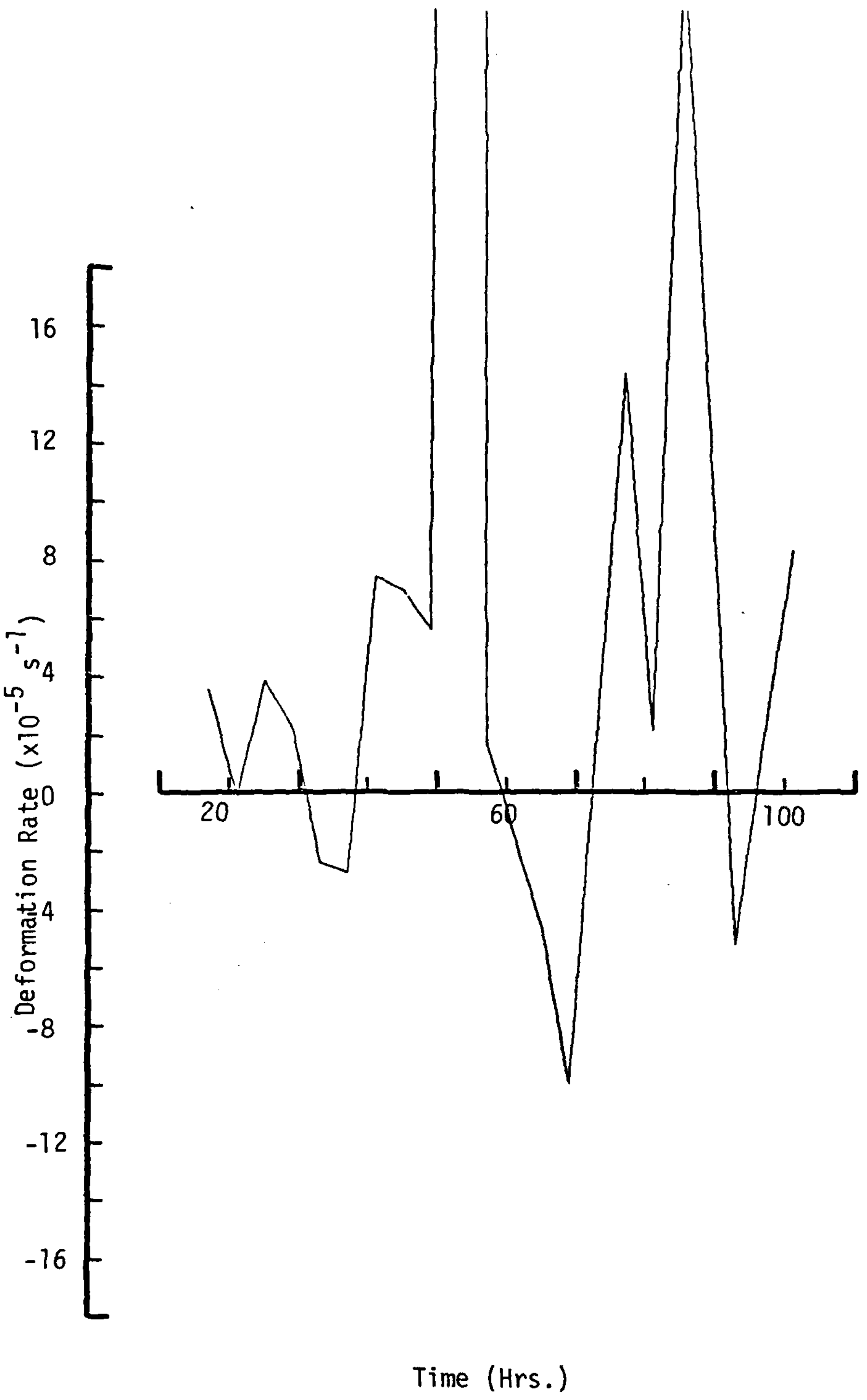
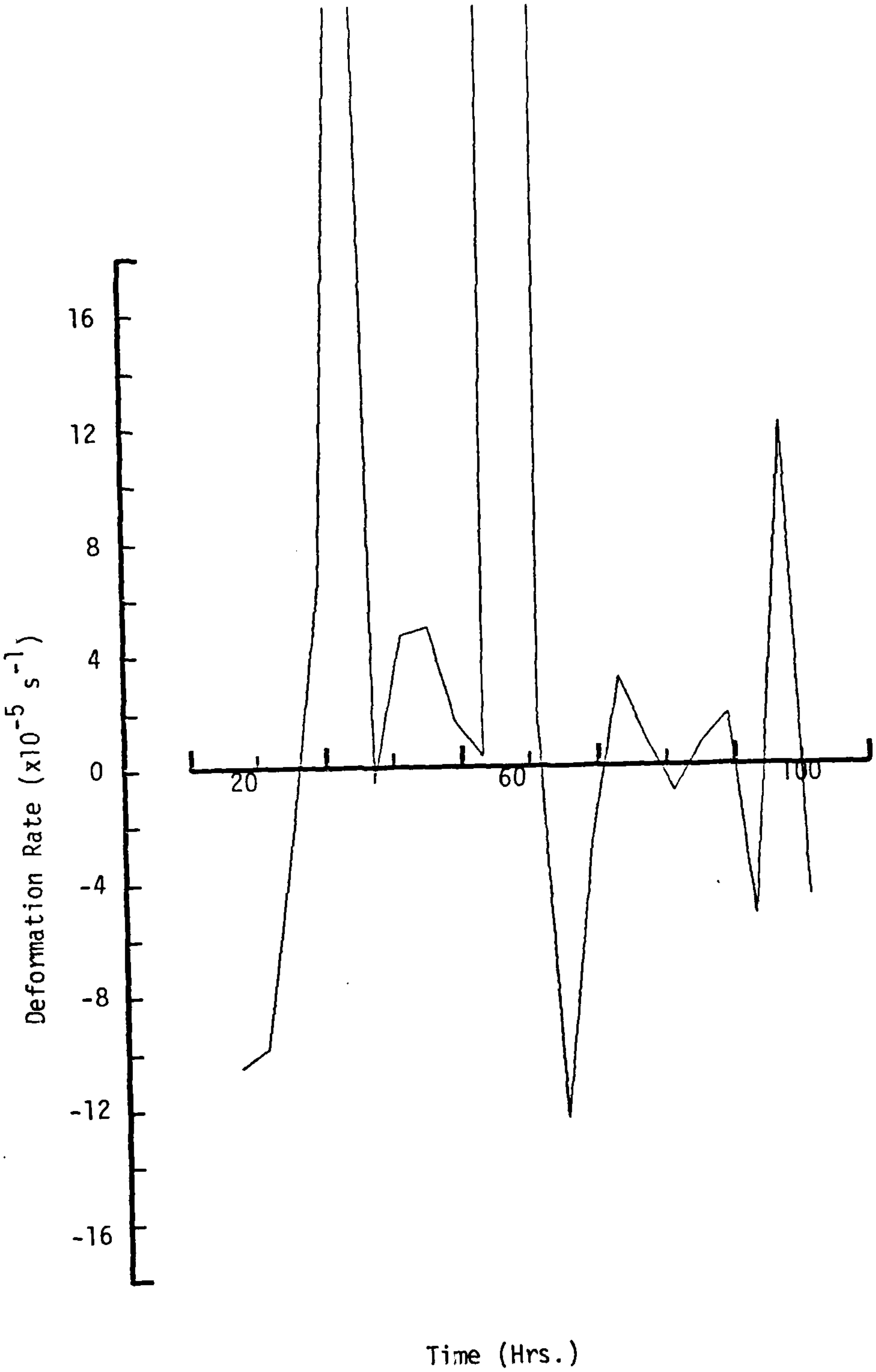
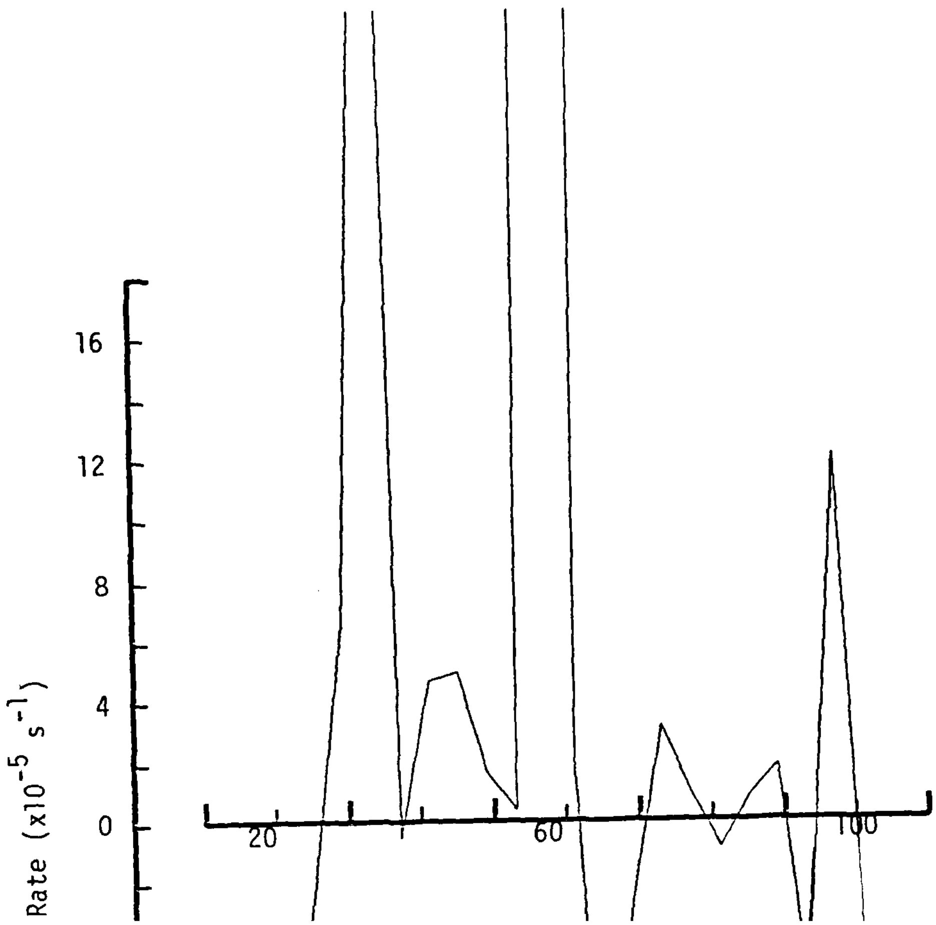
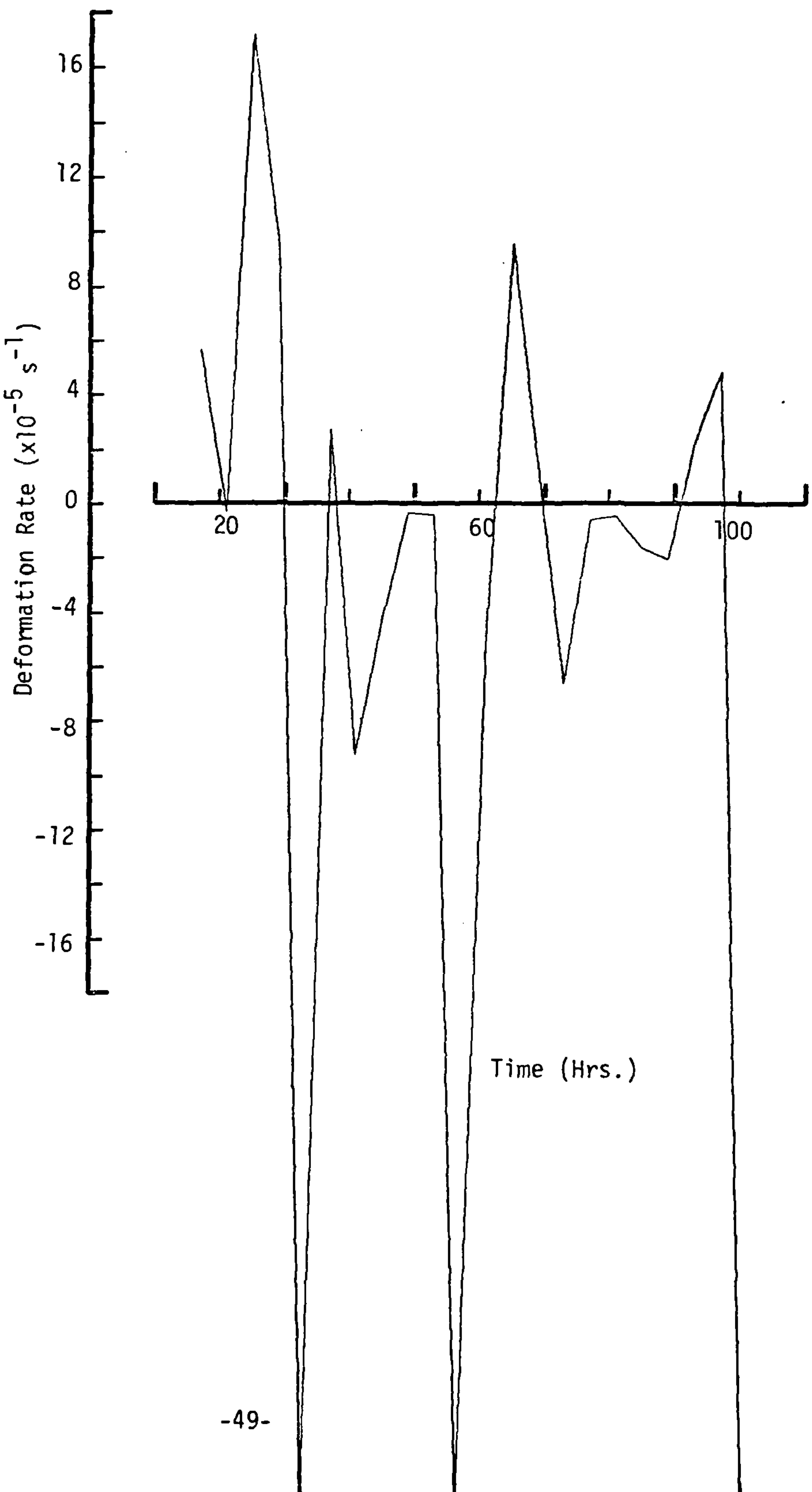

16
12
8
4
0
-4
-8
-12
-16
Deformation Rate ($x10^{-5} s^{-1}$)
20
60
100
Time (Hrs.)

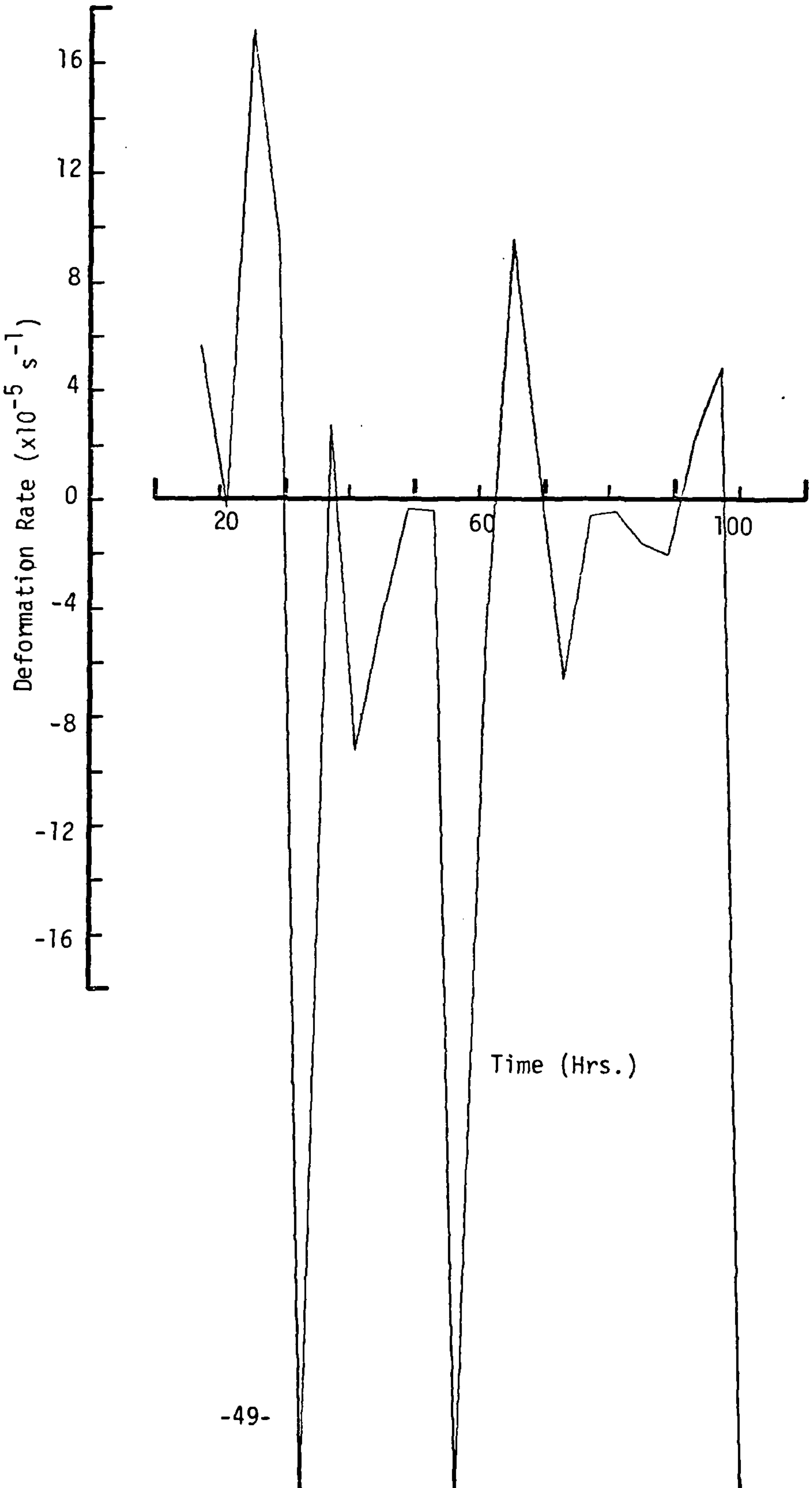
Fig. 21 Shear deformation rates for the small-scale cluster using every 4th data point (with corrections for position errors).

Fig. 21 Shear deformation rates for the small-scale cluster using every 4th data point (with corrections for position errors).


Deformation Rate (x10^{-5} s^{-1})
16
12
8
4
0
-4
-8
-12
-16
20
60
100
Time (Hrs.)


16
12
8
4
0
Rate (x10-5 s-1)
20
60
100


16
12
8
4
0
-4
-8
-12
-16
Deformation Rate ($x10^{-5}$ s^{-1})
20
60
100
Time (Hrs.)


16
12
8
4
0
-4
-8
-12
-16
Deformation Rate (x10^-5 s^-1)
20
60
100
Time (Hrs.)

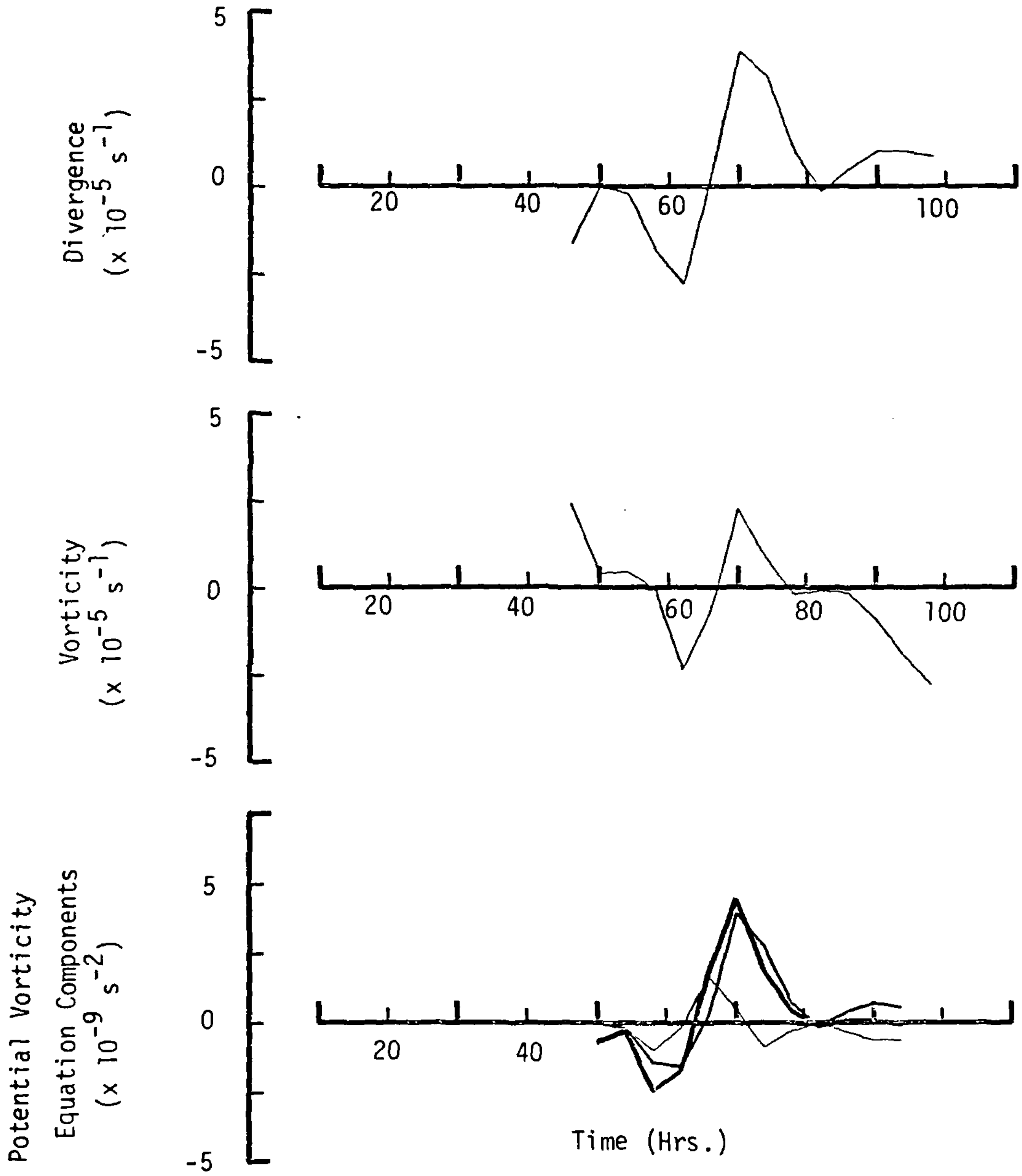


Fig. 23 Divergence, vorticity, and potential vorticity equation components for the large-scale cluster using every 4th data point (without corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.

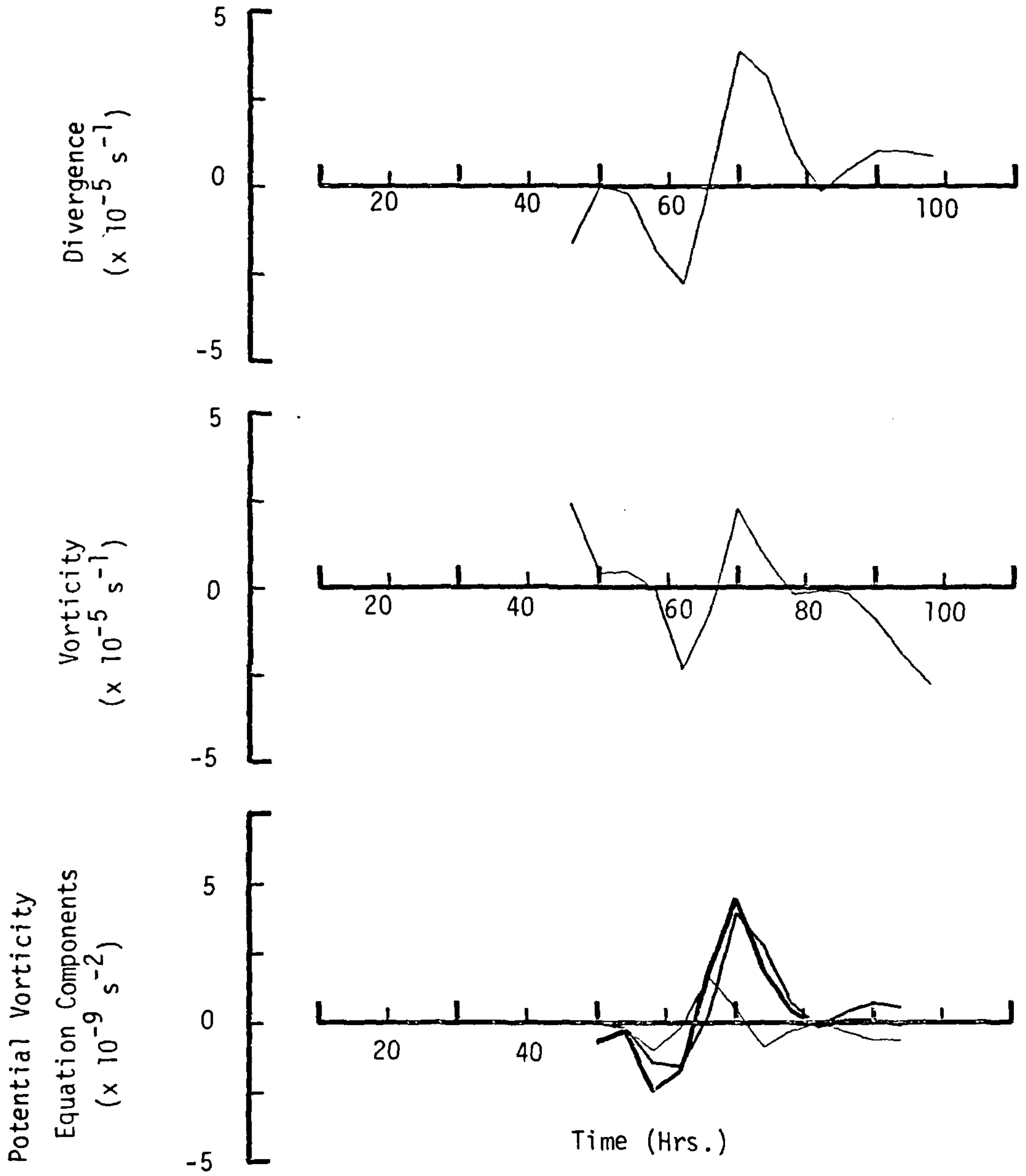


Fig. 23 Divergence, vorticity, and potential vorticity equation components for the large-scale cluster using every 4th data point (without corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.

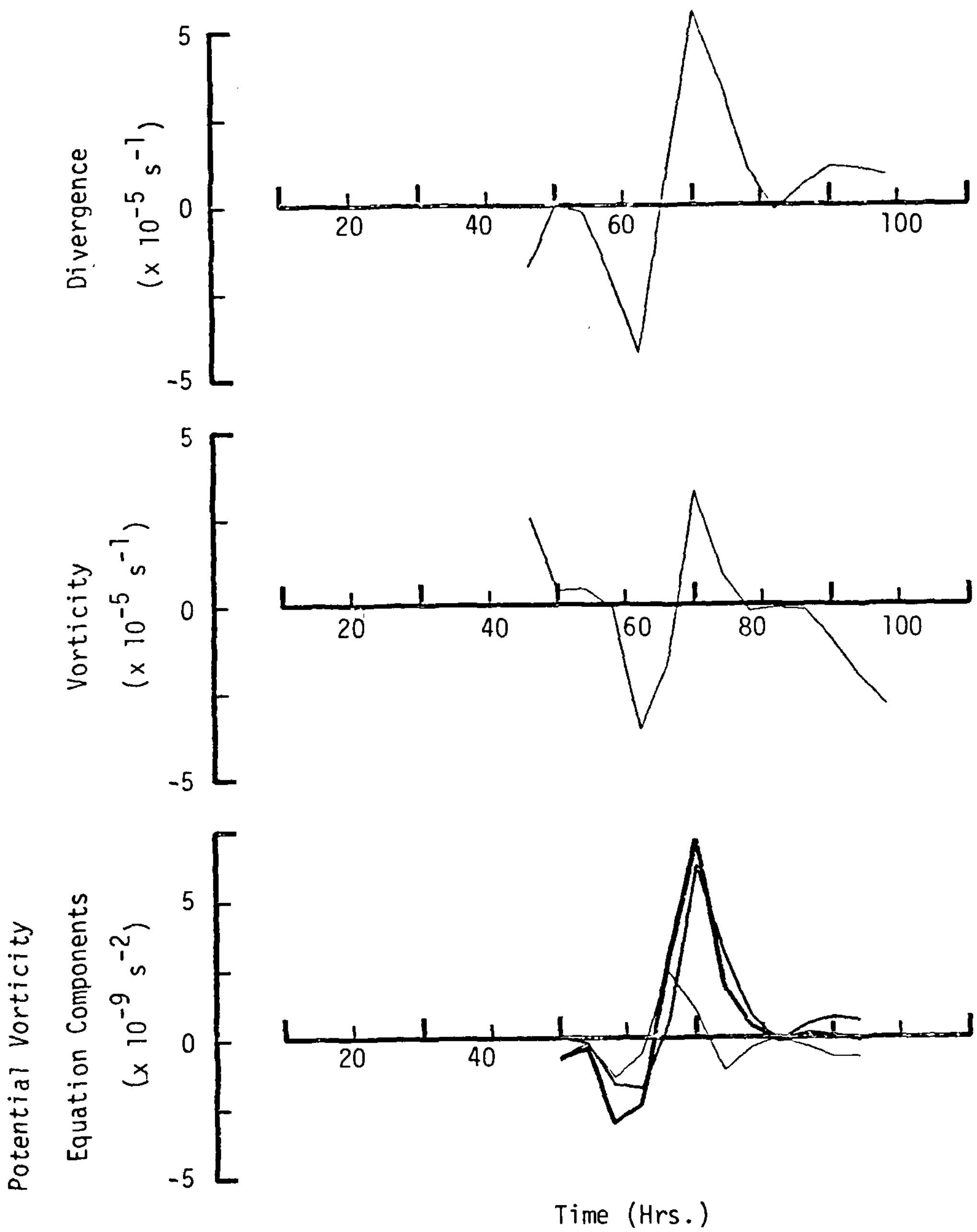


Fig. 24 Divergence, vorticity, and potential vorticity equation components for the large-scale cluster using every 4th data point (with corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.

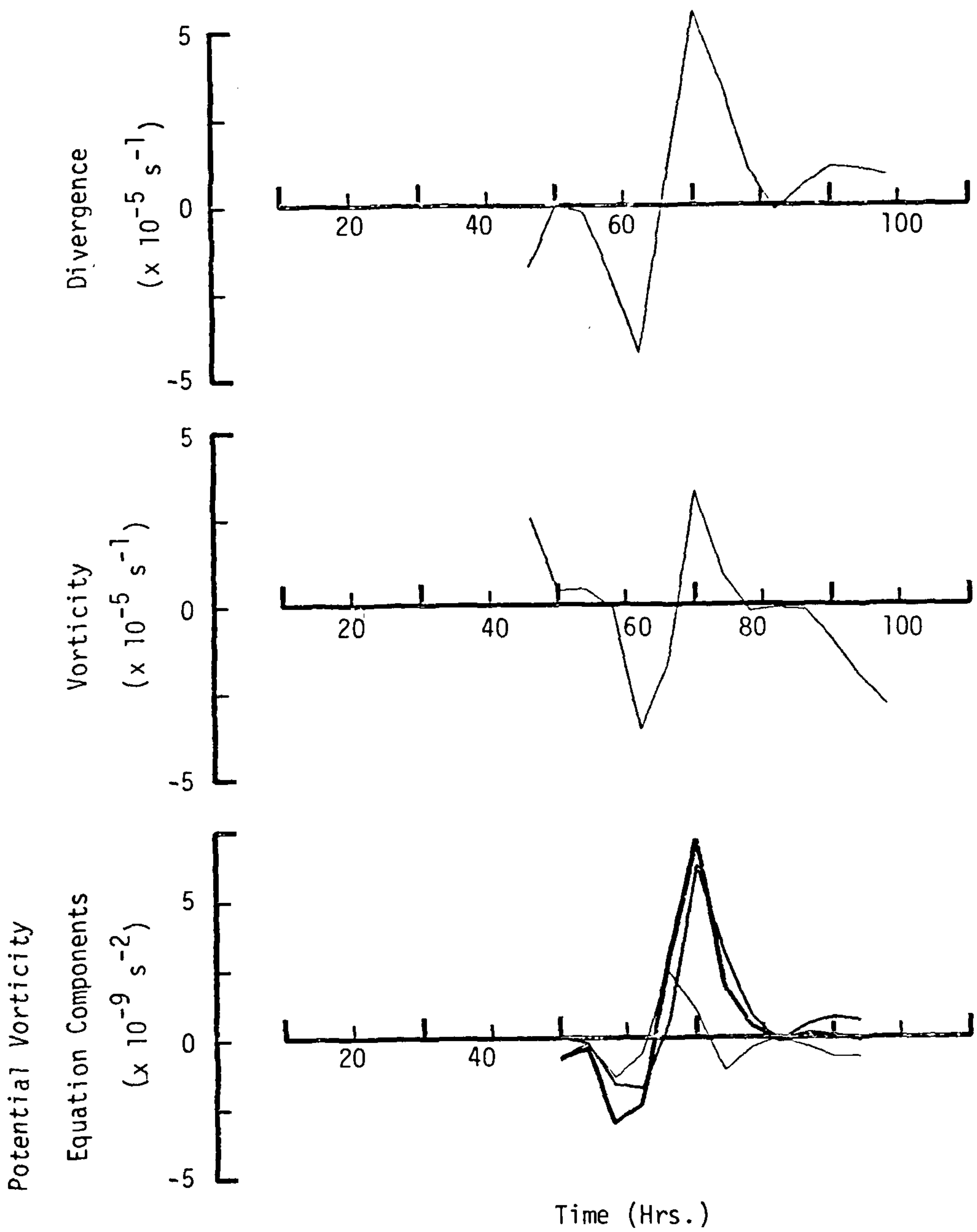
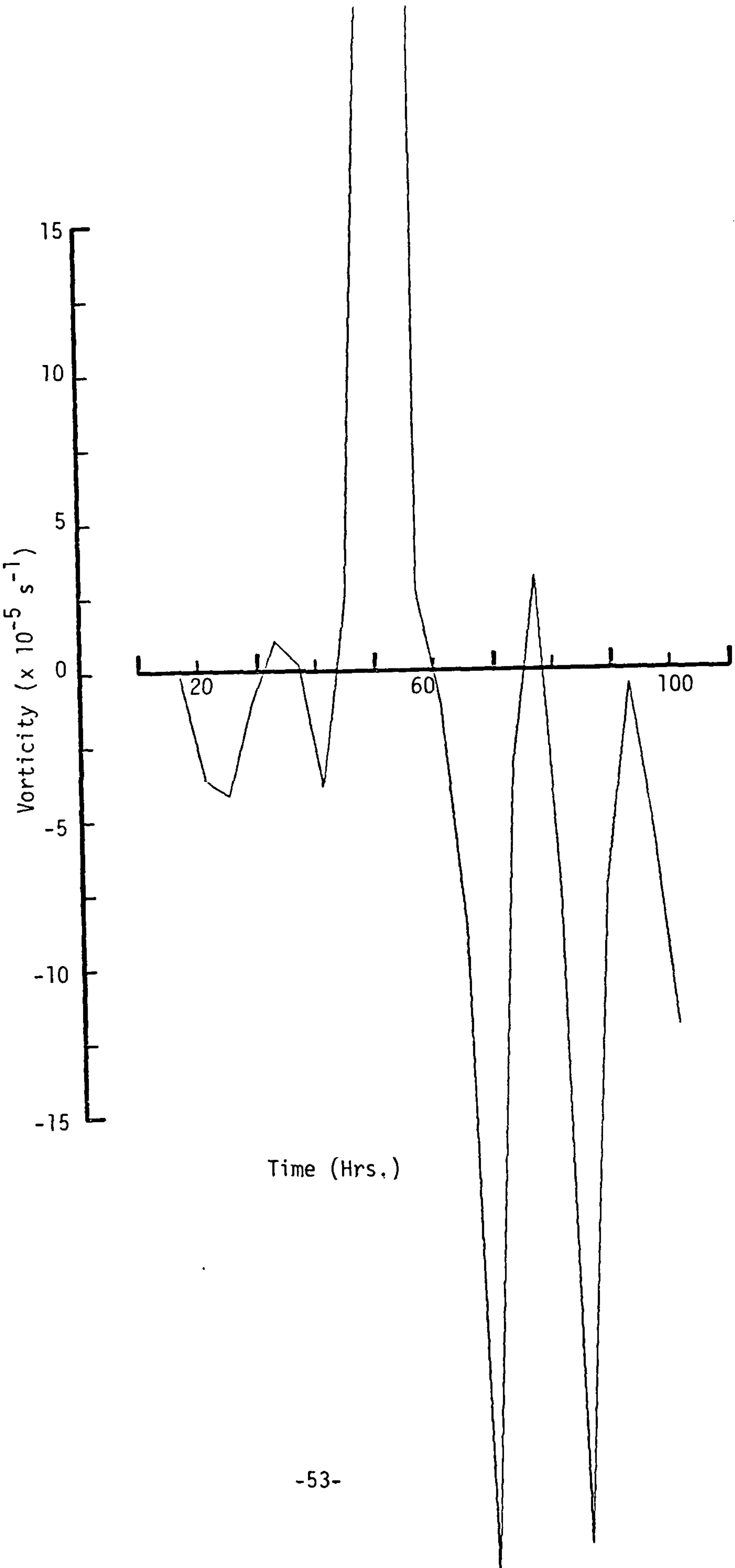


Fig. 24 Divergence, vorticity, and potential vorticity equation components for the large-scale cluster using every 4th data point (with corrections for position errors). For the equation components, the lightest line is the time derivative term, the medium line is the divergence-vorticity term, and the darkest line is the residual term.

Fig. 25 Vorticity for the small-scale cluster using every 4th data point (without corrections for position errors).

Fig. 25 Vorticity for the small-scale cluster using every 4th data point (without corrections for position errors).


15
10
5
0
-5
-10
-15
Vorticity (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

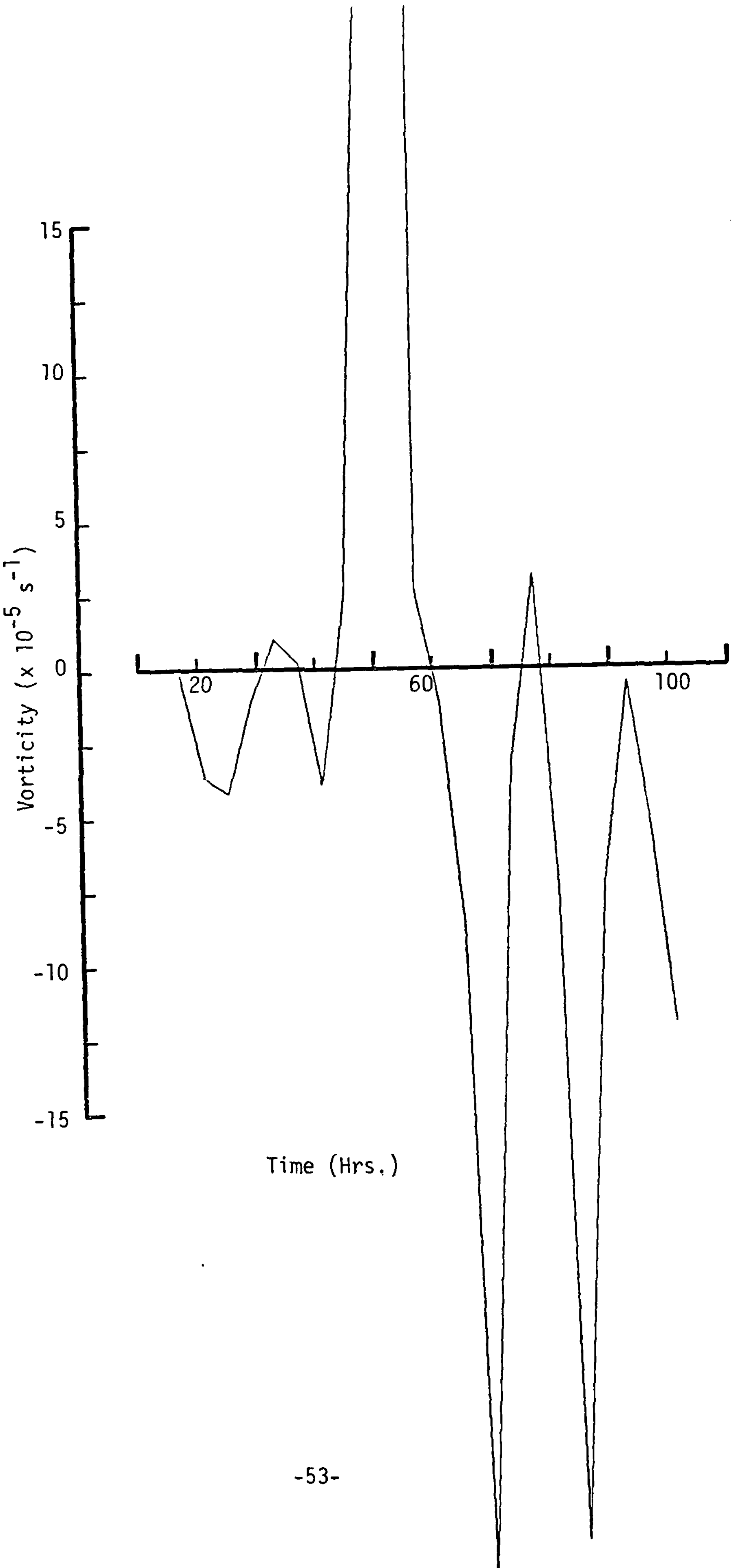
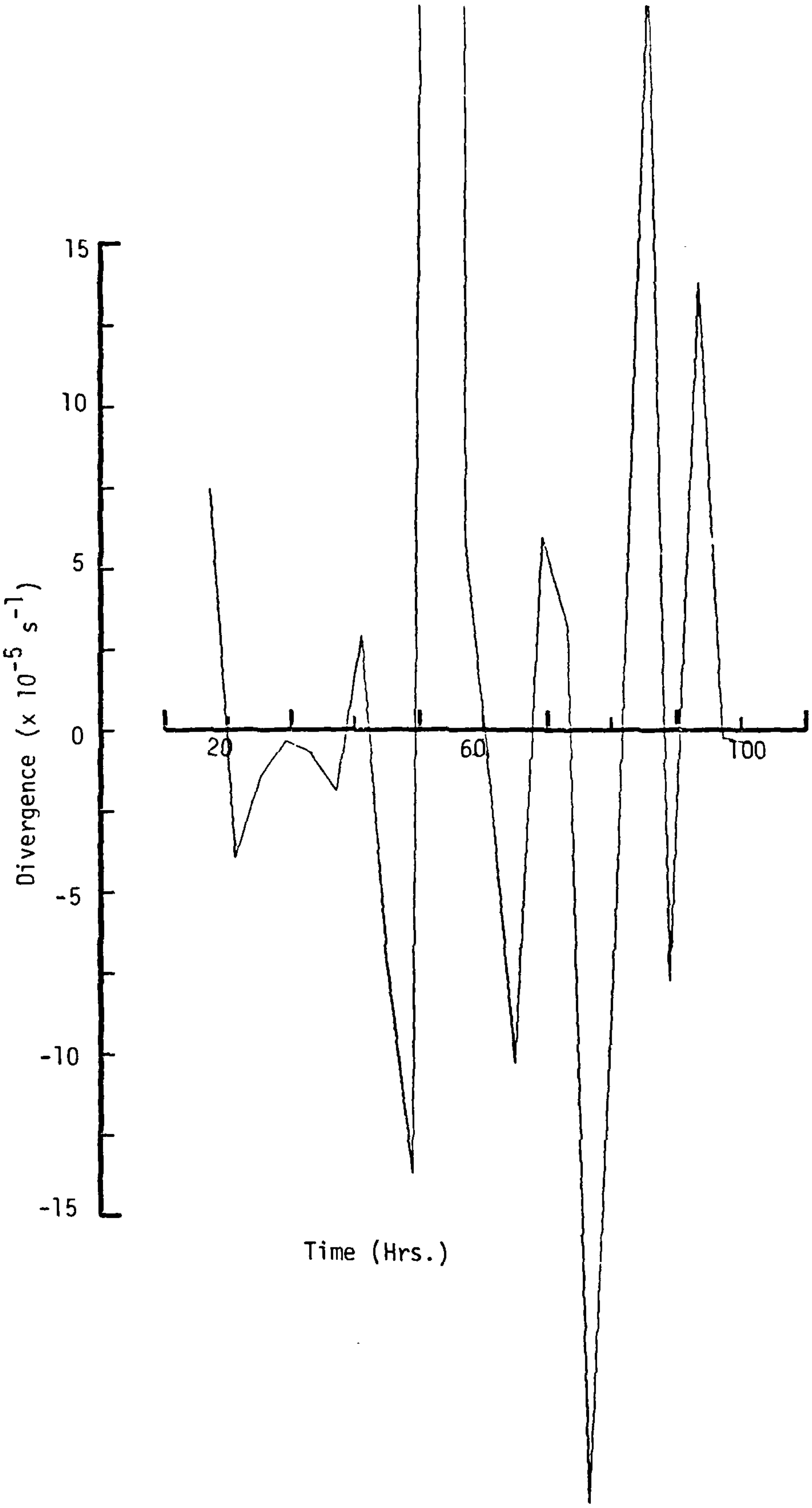

15
10
5
0
-5
-10
-15
Vorticity (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Fig. 26 Divergence for the small-scale cluster using every 4th data point (without corrections for position errors).

Fig. 26 Divergence for the small-scale cluster using every 4th data point (without corrections for position errors).



15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

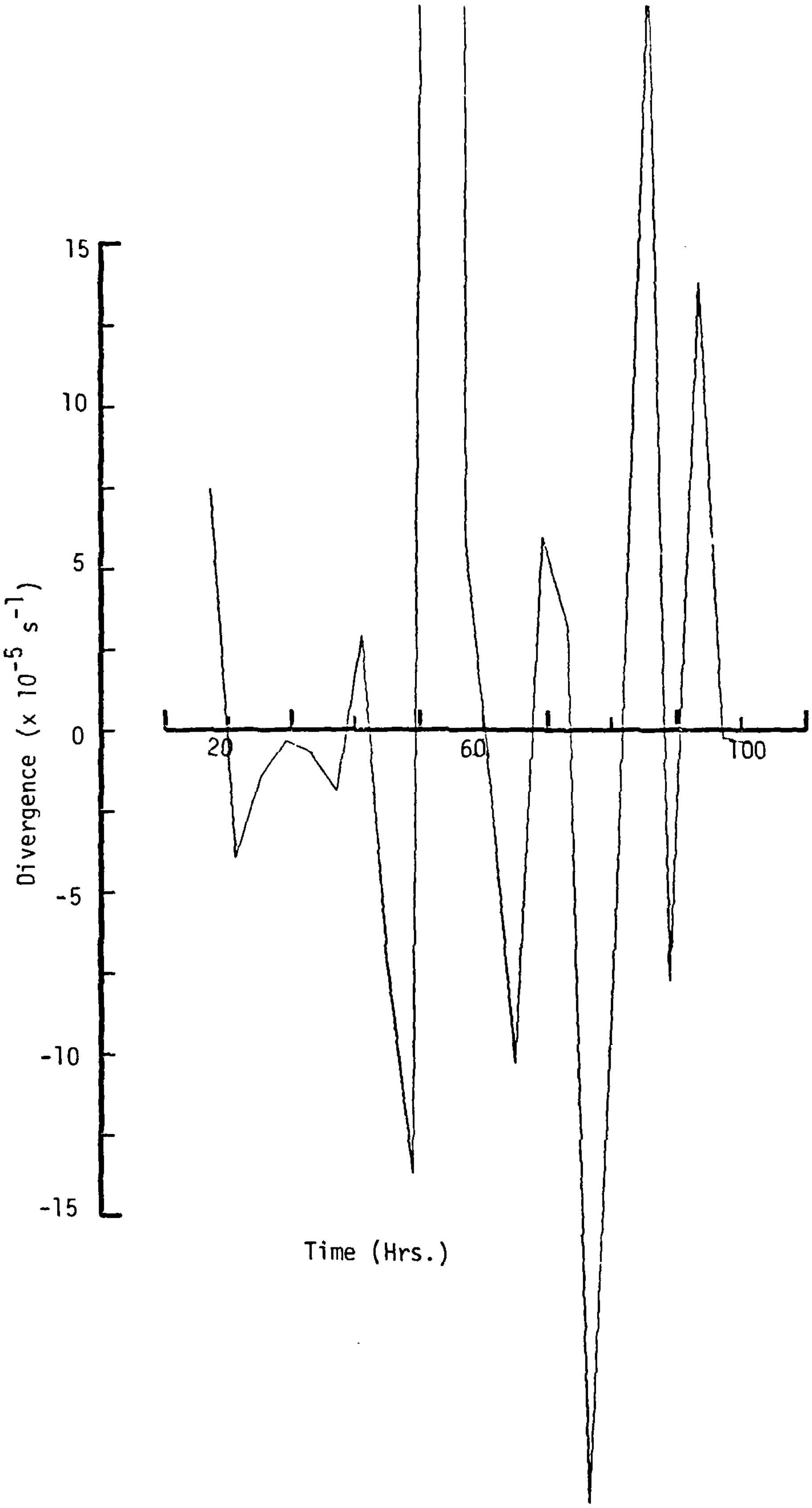
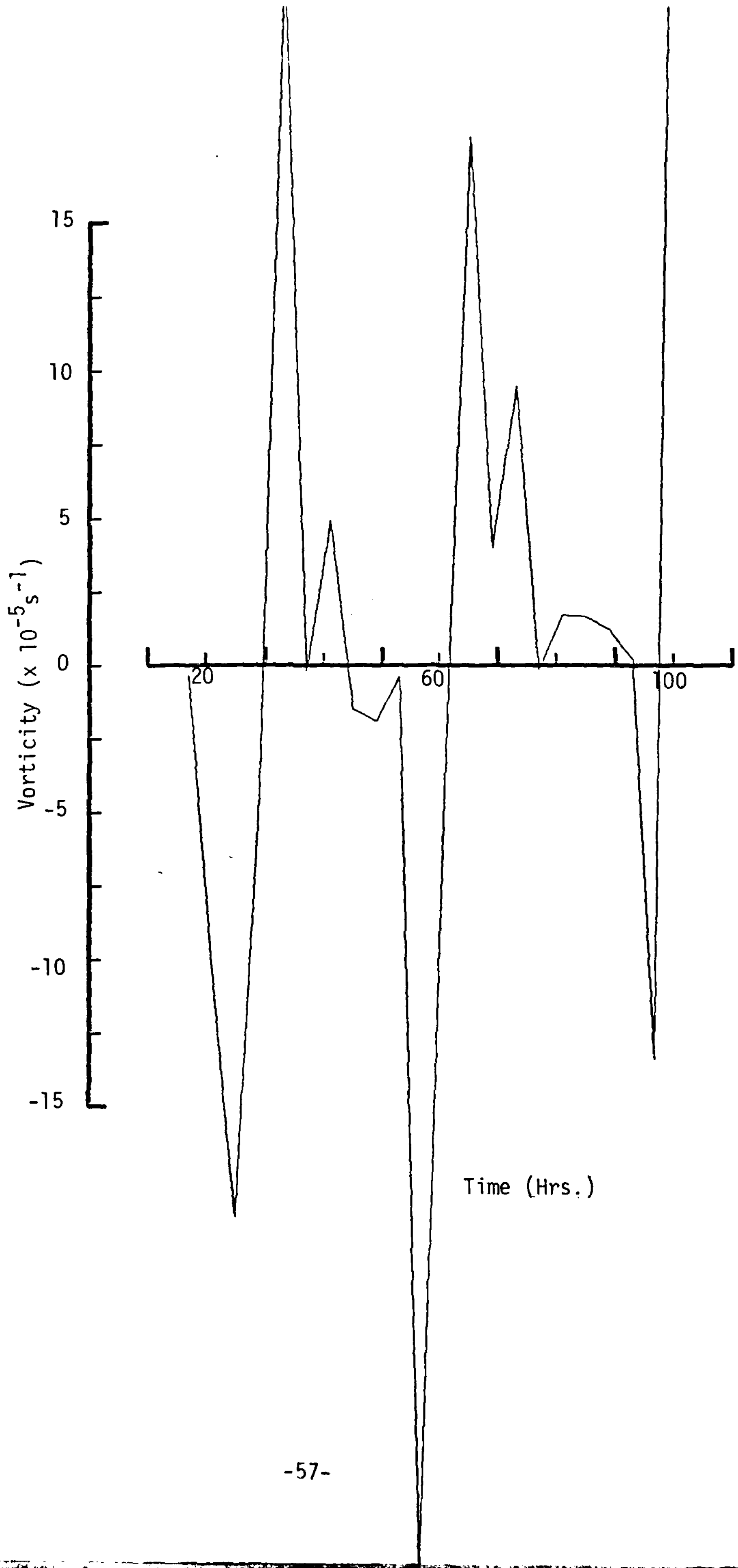

15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

Fig. 27 Vorticity for the small-scale cluster using every 4th data point (with corrections for position errors).

Fig. 27 Vorticity for the small-scale cluster using every 4th data point (with corrections for position errors).



15
10
5
0
-5
-10
-15
Vorticity (x $10^{-5}s^{-1}$)
20
60
100
Time (Hrs.)

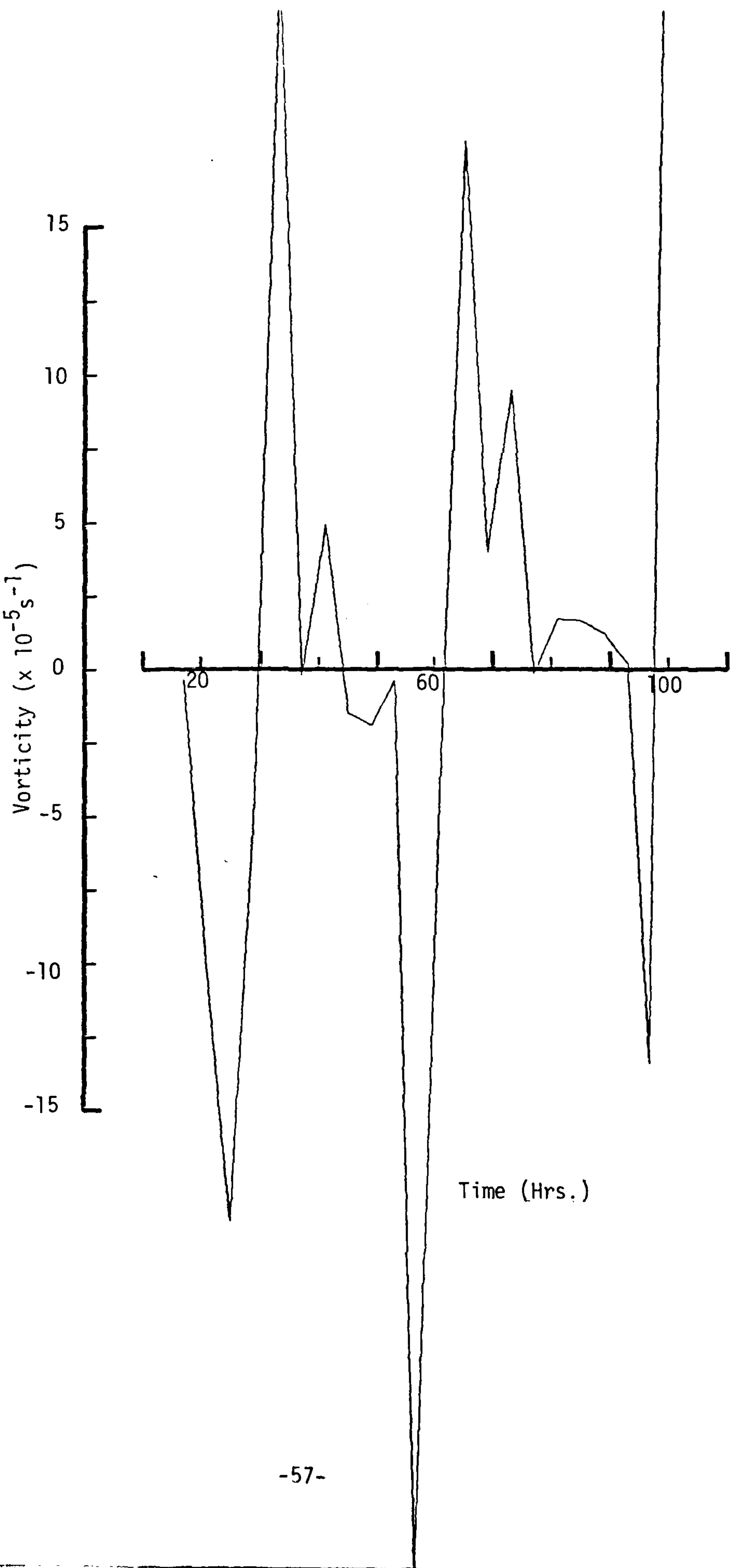
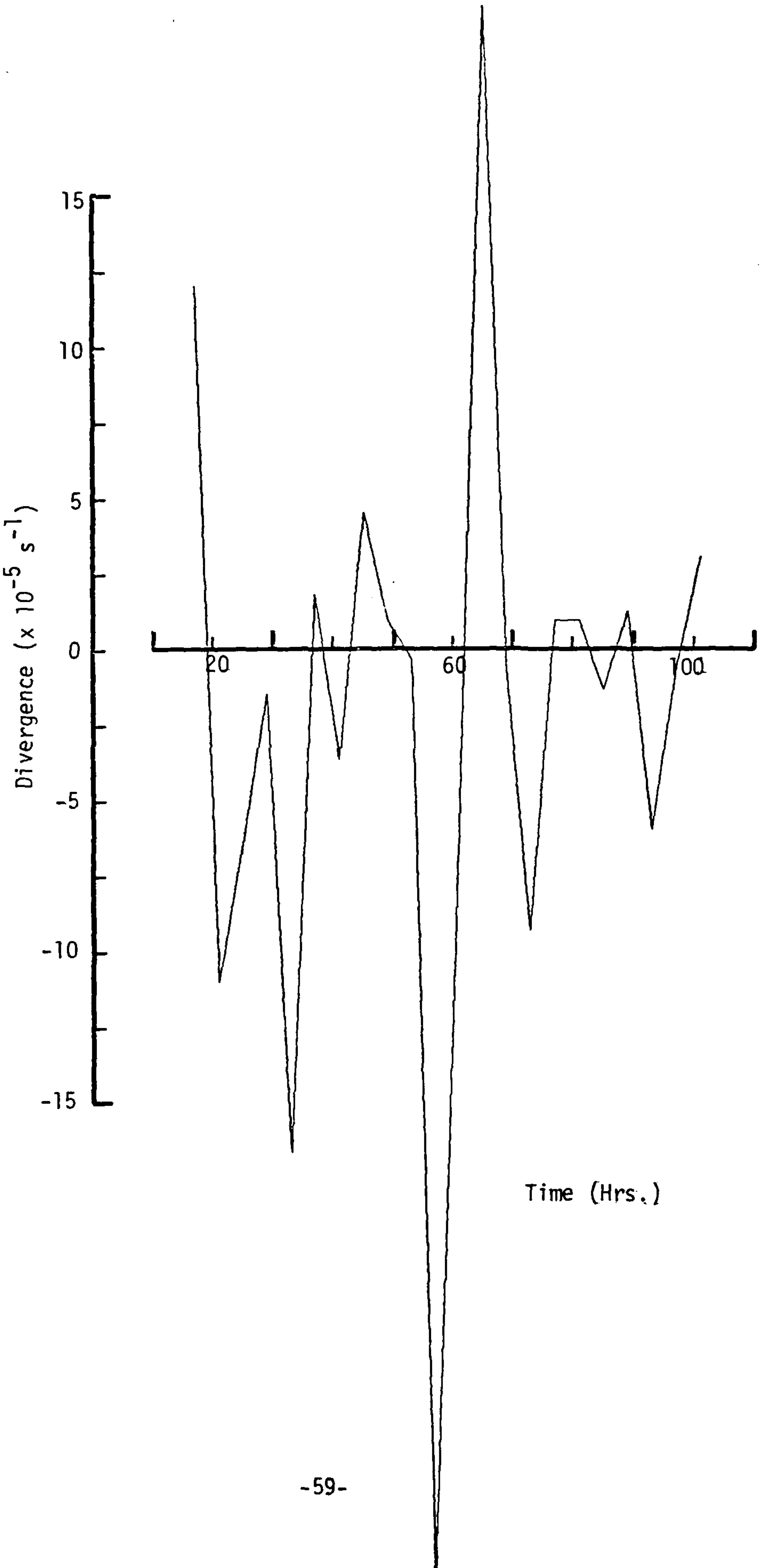

15
10
5
0
-5
-10
-15
Vorticity (x $10^{-5}s^{-1}$)
20
60
100
Time (Hrs.)

Fig. 28 Divergence for the small-scale cluster using every 4th data point (with corrections for position errors).


15
10
5
0
-5
-10
-15
Divergence (x 10^{-5} s^{-1})
20
60
100
Time (Hrs.)

5. Conclusions and Recommendations

There are several conclusions and recommendations which emerge from this study. These are discussed delow.

a. Perhaps the most important fact to emerge from this study is that the orders of magnitude for the DKP from the large-scale cluster are completely consistent with other studies. This strongly suggests that the data have provided useful qualitative information on horizontal shears.

Recommendation

In order to perform quantitative mechanisms in which horizontal shears are important, it will be necessary to use the original unsmoothed data to construct parallel estimates of the trajectories and velocities. Then, from this, the DKP and vorticity balance should be recalculated.

b. Tests of the interpolation routine and position error effect for the large-scale cluster suggested that neither played a significant role in the qualitative aspects of the results.

Recommendation

In any future calculations with this data, it would not be necessary to apply position error corrections. Any problems arising from the interpolation procedure would be overcome by following recommendation a.

c. Two quantative tests of the data were performed. They were the transformation to the natural coordinate system and the vorticity balance. There tests failed to provide quantitative information on horizontal shear mechanisms.

Recommendation

If Recommendation a is carried out, these calculations should be repeated.

d. The smoothed data from the small-scale cluster were not useful for determining small-scale processes. The DKP records were quite noisey with frequent changes of sign. Also, corrections for position errors substantially altered the character of the DKP. From this it appears that the problems are intrinsic to the smoothed data and not related to external sources of error.

Recommendation

In order to determine whether there is any useful information in this data, it will be necessary to use the original, unsmoothed data and perform parallel analysis for the trajectories and velocities, and then repeat the calculations.

e. All four DKP for the large-scale cluster as well as the residual in the vorticity balance showed a dramatic change of sign around hour 66. From the data supplied to us, we have been unable to isolate a likely cause.

Recommendation

The original position data, meteorological data and experimental log should be examined to determine if anything unusual occurred during that time period.

The recommendations given above apply to the data set on hand. These suggest, however, some recommendations for future experiments.

1. Parallel processing of the raw position data is essential.

2. It would have been better to have had one cluster with five drifters rather than separate large and small-scale clusters. One cluster with a large number of drifters should provide the same basic information as separate clusters but with added statistical reliability.

3. Hydrographic data taken along the trajectory of the center of mass of the cluster could have provided very important information on the residual of the vorticity equation. In the natural coordinate system, the baroclinic torque term is very nearly $\frac{\partial\alpha}{\partial T}\frac{\partial p}{\partial N}$ where T and N are in the tangential and normal directions of the trajectory. The hydrographic data (even XBT data) can supply a sense of $\frac{\partial\alpha}{\partial T}$. Since the flow is very nearly quasi-geostrophic, the sense of $\frac{\partial P}{\partial N}$ is known by inspection.

6. References

1. Gordon, C.M., 1980: Ltr. of 13 Nov. 1980, Serial 4345-153:CMG:M1.
2. Kirwan, A.D., G.J. McNally, M.-S. Chang, and R. Molinari, 1975: "The effect of wind and surface currents on drifters." J. Phys. Oceanogr., 5, 361-368.
3. Kirwan, A.D., and M.-S. Chang, 1979: "Effect of Sampling Rate and Random Position Error on Analysis of Drifter Data." J. Phys. Oceanogr., 9.2, 382-387.
4. Kirwan, A.D., 1975: "Oceanic Velocity Gradients." J. Phys. Oceanogr., 5.4, 729-735.
5. Molinari, R., and A.D. Kirwan, 1975: "Calculation of differential kinematic properties of the Yucatan Current from Lagrangian observations." J. Phys. Oceanogr., 5, 483-491.
6. Okubo, A., and C.C. Ebbesmeyer, 1976: "Determination of vorticity, divergence, and deformation rates from analysis of drogue observations." Deep Sea Research, 23, 349-352.

6. References

1. Gordon, C.M., 1980: Ltr. of 13 Nov. 1980, Serial 4345-153:CMG:Ml.
2. Kirwan, A.D., G.J. McNally, M.-S. Chang, and R. Molinari, 1975: "The effect of wind and surface currents on drifters." J. Phys. Oceanogr., 5, 361-368.
3. Kirwan, A.D., and M.-S. Chang, 1979: "Effect of Sampling Rate and Random Position Error on Analysis of Drifter Data." J. Phys. Oceanogr., 9.2, 382-387.
4. Kirwan, A.D., 1975: "Oceanic Velocity Gradients." J. Phys. Oceanogr., 5.4, 729-735.
5. Molinari, R., and A.D. Kirwan, 1975: "Calculation of differential kinematic properties of the Yucatan Current from Lagrangian observations." J. Phys. Oceanogr., 5, 483-491.
6. Okubo, A., and C.C. Ebbesmeyer, 1976: "Determination of vorticity, divergence, and deformation rates from analysis of drogue observations." Deep Sea Research, 23, 349-352.

Appendix A

The following is a listing of the computer program used to make the calculations for this study.

```
//DKP JOB (A043,01A,01,50,JL),'J.K.LEWIS'
/*JOBPARM       R=128
// EXEC FTNXVTEC,GOREGN=128K
//FORT.SYSIN DD *
      REAL N(160),IA(160)
      DIMENSION X(160,3),Y(160,3),VX(160,3),VY(160,3),D(160),
     1 VDR(160),S(160),XC(160),YC(160),VXC(160),VYC(160),
     2 NI(3),PA(160)
      CALL PLOTS(0,0,0)
C
C     READ IN TIME SPAN REQUIRED.
C
      READ(5,10) NS,NF
   10 FORMAT(16 I5)
      NP=NF-NS+1
C
C     READ IN DRIFTER NUM. AND ITS START AND END TIMES.
C
      DO 20 I=1,3
      READ(5,10) NI(I),IS,IF
C
C     READ IN THE DATA FOR THE NI(I) DRIFTER.
C
      DO 30 J=IS,IF,10
      READ(5,40) (X(J+K-1,I),K=1,10)
      DO 32 K=1,10
   32 X(J+K-1,I)=-X(J+K-1,I)
   30 CONTINUE
   40 FORMAT(10 F8.2)
      DO 50 J=IS,IF,10
   50 READ(5,40) (Y(J+K-1,I),K=1,10)
   20 CONTINUE
      ISP=NS+1
      IFM=NF-1
C
C     CALC.SPEED COMPONENTS.
C
      DENOM=2.*3600.
      TIME=3600.
      DO 31 J=1,3
      DO 31 K=ISP,IFM
      VX(K,J)=(X(K+1,J)-X(K-1,J))/DENOM
   31 VY(K,J)=(Y(K+1,J)-Y(K-1,J))/DENOM
C
C     CALC. POSITIONS AND VEL. OF CENTROID.
C
      DO 41 I=ISP,IFM
      SX=0.
      SY=0.
      SVX=0.
      SVY=0.
      DO 42 J=1,3
      SX=SX+X(I,J)
      SY=SY+Y(I,J)
      SVX=SVX+VX(I,J)
   42 SVY=SVY+VY(I,J)
      XC(I)=SX/3.
      YC(I)=SY/3.
      VXC(I)=SVX/3.
   41 VYC(I)=SVY/3.
```

```
C
C     CONVERT POSITIONS AND VELOCITIES RELATIVE TO CENTROID.
C
      DO 51 J=1,3
      DO 51 I=ISP,IFM
      X(I,J)=X(I,J)-XC(I)
      Y(I,J)=Y(I,J)-YC(I)
      VX(I,J)=VX(I,J)-VXC(I)
   51 VY(I,J)=VY(I,J)-VYC(I)
C
C     CALC. DKP OF SYSTEM.
C
      DO 61 I=ISP,IFM
      SXX=0.
      SXY=0.
      SYY=0.
      SVXX=0.
      SVXY=0.
      SVYY=0.
      SVYX=0.
      DO 62 J=1,3
      A1=X(I,J)
      A2=Y(I,J)
      B1=VX(I,J)
      B2=VY(I,J)
      SXX=SXX+A1*A1
      SXY=SXY+A1*A2
      SYY=SYY+A2*A2
      SVXX=SVXX+B1*A1
      SVXY=SVXY+B1*A2
      SVYY=SVYY+B2*A2
   62 SVYX=SVYX+B2*A1
C
C     FORM SPACIAL DERIVATIVES OF VELOCITIES.
C
      DENOM=SXY*SXY-SXX*SYY+350.**2*(SXX+SYY)+350.**4
C
C     THE FOLLOWING ARE FOR A 350 METER AVERAGE POSITION
C     ERROR.   THE TERMS HAVE BEEN MODIFIED TO ELIMINATE
C     BIASING DUE TO THIS ERROR.
C
      DVXDY=(SVXX*SXY-SVXY*SXX+350.*(SVXX+SVXY))/DENOM
      DVXDX=(SVXX*SYY-SVXY*SXY-350.*(SVXX+SVXY))/(-DENOM)
      DVYDY=(SVYX*SXY-SVYY*SXX+350.*(SVYX+SVYY))/DENOM
      DVYDX=(SVYX*SYY-SVYY*SXY-350.*(SVYX+SVYY))/(-DENOM)
C
C     FORM DKP.
C
      D(I)=DVXDX+DVYDY
      VOR(I)=DVYDX-DVXDY
      N(I)=DVXDX-DVYDY
   61 S(I)=DVXDY+DVYDX
C
C      WRITE OUT RESULTS.
C
      WRITE(6,6)
      DO 100 I=ISP,IFM
  100 WRITE(6,101) I,D(I),VOR(I),N(I),S(I),XC(I),YC(I)
    6 FORMAT(' HOUR      DIVER       VORTY        N DEF         S DEF     X CENTER
     1 Y CENTER',//)
  101 FORMAT(1X,I6,E10.3,5 (E9.2,1X))
```

```
C
C     NOW MAKE CALC.S FOR A NATURAL COORDINATE SYSTEM.
C
      DO 1000 I=ISP,IFM
      X(I,1)=ATAN2(VYC(I),VXC(I))*180./3.14159-90.
      X(I,2)=S(I)/(VYC(I)**2-VXC(I)**2)
      X(I,3)=N(I)-X(I,2)*2.*VXC(I)*VYC(I)
      Y(I,1)=SQRT(VXC(I)**2+VYC(I)**2)
      Y(I,2)=(N(I)*(VYC(I)**2-VXC(I)**2)-2.*S(I)*VXC(I)*
     1      VYC(I))/Y(I,1)**2
 1000 Y(I,3)=(S(I)*(VYC(I)**2-VXC(I)**2)+2.*N(I)*VXC(I)*
     1      VYC(I))/Y(I,1)**2
      WRITE(6,1020)
 1020 FORMAT('1THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM',
     1 //' HOUR    ALPHA     EQ 19     EQ 18     SPEED     N DEF     S DEF',
     2//)
      DO 1010 I=ISP,IFM
      WRITE(6,101) I,(X(I,K),K=1,3),(Y(I,K),K=1,3)
 1010 CONTINUE
C
C     PLOT
C
      DO 3000 I=ISP,IFM
      IA(I-ISP+1)=I
 3000 PA(I-ISP+1)=Y(I,3)
      CALL SET(3.,7.,2.8,4.8,10.,110.,-0.00006,+.00006,1)
      CALL HALFAX(5,2,1,6,0.,0.,0,0)
      CALL CURVE(IA,PA,IFM-ISP+1)
      CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00006,.00006,1)
      CALL HALFAX(5,2,1,6,0.,0.,0,0)
      DO 3010 I=ISP,IFM
 3010 PA(I-ISP+1)=S(I)
      CALL CURVE(IA,PA,IFM-ISP+1)
      CALL PLOT(0,0,-999)
      CALL SET(3.,7.,2.8,4.8,10.,110.,-0.00006,+0.00006,1)
      CALL HALFAX(5,2,1,6,0.,0.,0,0)
      DO 3030 I=ISP,IFM
 3030 PA(I-ISP+1)=Y(I,2)
      CALL CURVE(IA,PA,IFM-ISP+1)
      CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00006,+0.00006,1)
      CALL HALFAX(5,2,1,6,0.,0.,0,0)
      DO 3040 I=ISP,IFM
 3040 PA(I-ISP+1)=N(I)
      CALL CURVE(IA,PA,IFM-ISP+1)
      CALL PLOT(0,0,-999)
C
C     CALC. POT. VORT. EQN. COMP.'S.
C
      WRITE(6,2001)
 2001 FORMAT('1POT. VORT. EQN. COMP. S',//' HOUR    TIME DER   DIV*VOR
     1RES'//)
      DENOM=2.*3600.
      ISS=NS+2
      IFF=NF-2
      F=1.458E-04*SIN(32.*2.*3.14159/360.)
      DO 2000 I=ISS,IFF
      FO=F+YC(I-1)*1.941E-11
      FN=F+YC(I+1)*1.941E-11
      FR=F+YC(I)*1.941E-11
      X(I,1)=(VOR(I+1)+FN-VOR(I-1)-FO)/DENOM
      X(I,2)=D(I)*(VOR(I)+FR)
```

```
C
C      NOW MAKE CALC.S FOR A NATURAL COORDINATE SYSTEM.
C
       DO 1000 I=ISP,IFM
       X(I,1)=ATAN2(VYC(I),VXC(I))*180./3.14159-90.
       X(I,2)=S(I)/(VYC(I)**2-VXC(I)**2)
       X(I,3)=N(I)-X(I,2)*2.*VXC(I)*VYC(I)
       Y(I,1)=SQRT(VXC(I)**2+VYC(I)**2)
       Y(I,2)=(N(I)*(VYC(I)**2-VXC(I)**2)-2.*S(I)*VXC(I)*
      1       VYC(I))/Y(I,1)**2
  1000 Y(I,3)=(S(I)*(VYC(I)**2-VXC(I)**2)+2.*N(I)*VXC(I)*
      1       VYC(I))/Y(I,1)**2
       WRITE(6,1020)
  1020 FORMAT('1THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM',
      1 //' HOUR   ALPHA     EQ 19     EQ 18     SPEED     N DEF     S DEF',
      2//)
       DO 1010 I=ISP,IFM
       WRITE(6,101) I,(X(I,K),K=1,3),(Y(I,K),K=1,3)
  1010 CONTINUE
C
C      PLOT
C
       DO 3000 I=ISP,IFM
       IA(I-ISP+1)=I
  3000 PA(I-ISP+1)=Y(I,3)
       CALL SET(3.,7.,2.8,4.8,10.,110.,-0.00006,+.00006,1)
       CALL HALFAX(5,2,1,6,0.,0.,0,0)
       CALL CURVE(IA,PA,IFM-ISP+1)
       CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00006,.00006,1)
       CALL HALFAX(5,2,1,6,0.,0.,0,0)
       DO 3010 I=ISP,IFM
  3010 PA(I-ISP+1)=S(I)
       CALL CURVE(IA,PA,IFM-ISP+1)
       CALL PLOT(0,0,-999)
       CALL SET(3.,7.,2.8,4.8,10.,110.,-0.00006,+0.00006,1)
       CALL HALFAX(5,2,1,6,0.,0.,0,0)
       DO 3030 I=ISP,IFM
  3030 PA(I-ISP+1)=Y(I,2)
       CALL CURVE(IA,PA,IFM-ISP+1)
       CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00006,+0.00006,1)
       CALL HALFAX(5,2,1,6,0.,0.,0,0)
       DO 3040 I=ISP,IFM
  3040 PA(I-ISP+1)=N(I)
       CALL CURVE(IA,PA,IFM-ISP+1)
       CALL PLOT(0,0,-999)
C
C      CALC. POT. VORT. EQN. COMP.'S.
C
       WRITE(6,2001)
  2001 FORMAT('1POT. VORT. EQN. COMP. S',//' HOUR   TIME DER   DIV*VOR
      1RES'//)
       DENOM=2.*3600.
       ISS=NS+2
       IFF=NF-2
       F=1.458E-04*SIN(32.*2.*3.14159/360.)
       DO 2000 I=ISS,IFF
       FO=F+YC(I-1)*1.941E-11
       FN=F+YC(I+1)*1.941E-11
       FR=F+YC(I)*1.941E-11
       X(I,1)=(VOR(I+1)+FN-VOR(I-1)-FO)/DENOM
       X(I,2)=D(I)*(VOR(I)+FR)
```

```
      X(I,3)=X(I,1)+X(I,2)
 2000 WRITE(6,101) I,X(I,1),X(I,2),X(I,3)
C
C     PLOT
C
      CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00005,+0.00005,1)
      CALL HALFAX(5,2,1,4,0.,0.,0,0)
      DO 2040 I=ISP,IFM
      IA(I-ISP+1)=I
 2040 PA(I-ISP+1)=VUR(I)
      CALL CURVE(IA,PA,IFM-ISP+1)
      CALL SET(3.,7.,7.4,9.4,10.,110.,-0.00005,+0.00005,1)
      CALL HALFAX(5,2,1,4,0.,0.,0,0)
      DO 2050 I=ISP,IFM
 2050 PA(I-ISP+1)=D(I)
      CALL CURVE(IA,PA,IFM-ISP+1)
      DO 2010 I=ISS,IFF
      IA(I-ISS+1)=I
      PA(I-ISS+1)=X(I,1)
 2010 CONTINUE
      CALL SET(3.,7.,2.8,4.8,10.,110.,-0.000000005,+0.0000000075,1)
      CALL HALFAX(5,2,1,5,0.,0.,0,0)
      CALL NEWPEN(1)
      CALL CURVE(IA,PA,IFF-ISS+1)
      CALL NEWPEN(3)
      DO 2020 I=ISS,IFF
 2020 PA(I-ISS+1)=X(I,2)
      CALL CURVE(IA,PA,IFF-ISS+1)
      CALL NEWPEN(5)
      DO 2030 I=ISS,IFF
 2030 PA(I-ISS+1)=X(I,3)
      CALL CURVE(IA,PA,IFF-ISS+1)
      CALL PLOT(0,0,-999)
      CALL PLOT(0,0,+999)
      STOP
      END
//LKED.PLOTLIB DD DSN=USER.DCN.GUINASSO.JOBLIB,DISP=SHR
//LKED.SYSIN DD *
 INCLUDE PLOTLIB(PLOTVTEC,PERIM,PWRX)
//GO.SYSIN DD DSN=WYL.JL.ABH.LARG,DISP=SHR
/*END
```

```
               X(I,3)=X(I,1)+X(I,2)
         2000  WRITE(6,101) I,X(I,1),X(I,2),X(I,3)
      C
      C        PLOT
      C
               CALL SET(3.,7.,5.1,7.1,10.,110.,-0.00005,+0.00005,1)
               CALL HALFAX(5,2,1,4,0.,0.,0,0)
               DO 2040 I=ISP,IFM
               IA(I-ISP+1)=I
         2040  PA(I-ISP+1)=VOR(I)
               CALL CURVE(IA,PA,IFM-ISP+1)
               CALL SET(3.,7.,7.4,9.4,10.,110.,-0.00005,+0.00005,1)
               CALL HALFAX(5,2,1,4,0.,0.,0,0)
               DO 2050 I=ISP,IFM
         2050  PA(I-ISP+1)=D(I)
               CALL CURVE(IA,PA,IFM-ISP+1)
               DO 2010 I=ISS,IFF
               IA(I-ISS+1)=I
               PA(I-ISS+1)=X(I,1)
         2010  CONTINUE
               CALL SET(3.,7.,2.8,4.8,10.,110.,-0.000000005,+0.0000000075,1)
               CALL HALFAX(5,2,1,5,0.,0.,0,0)
               CALL NEWPEN(1)
               CALL CURVE(IA,PA,IFF-ISS+1)
               CALL NEWPEN(3)
               DO 2020 I=ISS,IFF
         2020  PA(I-ISS+1)=X(I,2)
               CALL CURVE(IA,PA,IFF-ISS+1)
               CALL NEWPEN(5)
               DO 2030 I=ISS,IFF
         2030  PA(I-ISS+1)=X(I,3)
               CALL CURVE(IA,PA,IFF-ISS+1)
               CALL PLOT(0,0,-999)
               CALL PLOT(0,0,+999)
               STOP
               END
      //LKED.PLOTLIB DD DSN=USER.DCN.GUINASSO.JOBLIB,DISP=SHR
      //LKED.SYSIN DD *
        INCLUDE PLOTLIB(PLOTVTEC,PERIM,PWRX)
      //GO.SYSIN DD DSN=WYL.JL.ABH.LARG,DISP=SHR
      /*END
```

Appendix B

The following are tables of the output from the production runs.

Appendix B

The following are tables of the output from the production runs.

Table B-1 DKP and the location of the center of mass for the large-scale cluster (without corrections for position errors). This data is for a geographic coordinate system.

Table B-1 DKP and the location of the center of mass for the large-scale cluster (without corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
43	-0.378E-04	0.32E-04	0.35E-04	-0.37E-04	0.11E+06	0.15E+06
44	-0.262E-04	0.31E-04	0.33E-04	-0.38E-04	0.11E+06	0.14E+06
45	-0.162E-04	0.28E-04	0.31E-04	-0.36E-04	0.10E+06	0.14E+06
46	-0.804E-05	0.24E-04	0.28E-04	-0.32E-04	0.10E+06	0.14E+06
47	-0.226E-05	0.19E-04	0.25E-04	-0.26E-04	0.10E+06	0.14E+06
48	0.101E-05	0.12E-04	0.23E-04	-0.20E-04	0.10E+06	0.14E+06
49	0.222E-05	0.45E-05	0.20E-04	-0.12E-04	0.10E+06	0.13E+06
50	0.125E-05	-0.41E-05	0.18E-04	-0.27E-05	0.10E+06	0.13E+06
51	0.285E-06	-0.95E-05	0.18E-04	0.27E-05	0.10E+06	0.13E+06
52	0.602E-06	-0.70E-05	0.20E-04	0.65E-07	0.10E+06	0.13E+06
53	0.154E-05	0.16E-05	0.25E-04	-0.87E-05	0.10E+06	0.13E+06
54	0.804E-06	0.11E-04	0.29E-04	-0.19E-04	0.10E+06	0.13E+06
55	-0.182E-05	0.20E-04	0.33E-04	-0.27E-04	0.10E+06	0.12E+06
56	-0.737E-05	0.17E-04	0.35E-04	-0.25E-04	0.10E+06	0.12E+06
57	-0.145E-04	0.58E-05	0.35E-04	-0.15E-04	0.10E+06	0.12E+06
58	-0.207E-04	-0.49E-05	0.37E-04	-0.40E-05	0.10E+06	0.12E+06
59	-0.259E-04	-0.14E-04	0.38E-04	0.31E-05	0.10E+06	0.12E+06
60	-0.299E-04	-0.22E-04	0.40E-04	0.10E-04	0.10E+06	0.12E+06
61	-0.320E-04	-0.27E-04	0.41E-04	0.15E-04	0.10E+06	0.12E+06
62	-0.322E-04	-0.30E-04	0.40E-04	0.18E-04	0.10E+06	0.11E+06
63	-0.287E-04	-0.33E-04	0.36E-04	0.21E-04	0.10E+06	0.11E+06
64	-0.194E-04	-0.28E-04	0.25E-04	0.19E-04	0.10E+06	0.11E+06
65	-0.124E-04	-0.21E-04	0.16E-04	0.14E-04	0.10E+06	0.11E+06
66	-0.431E-05	-0.10E-04	0.58E-05	0.56E-05	0.10E+06	0.11E+06
67	0.151E-04	0.33E-05	-0.16E-04	-0.12E-05	0.99E+05	0.11E+06
68	0.267E-04	0.15E-04	-0.30E-04	-0.82E-05	0.99E+05	0.11E+06
69	0.352E-04	0.26E-04	-0.41E-04	-0.15E-04	0.98E+05	0.10E+06
70	0.417E-04	0.32E-04	-0.46E-04	-0.19E-04	0.97E+05	0.10E+06
71	0.420E-04	0.35E-04	-0.48E-04	-0.21E-04	0.97E+05	0.10E+06
72	0.402E-04	0.37E-04	-0.45E-04	-0.23E-04	0.96E+05	0.10E+06
73	0.441E-04	0.15E-04	-0.40E-04	-0.21E-06	0.95E+05	0.99E+05
74	0.403E-04	0.23E-05	-0.31E-04	0.12E-04	0.94E+05	0.97E+05
75	0.308E-04	0.57E-05	-0.22E-04	0.65E-05	0.93E+05	0.96E+05
76	0.260E-04	-0.28E-05	-0.14E-04	0.14E-04	0.92E+05	0.95E+05
77	0.200E-04	-0.62E-05	-0.64E-05	0.18E-04	0.91E+05	0.93E+05
78	0.131E-04	-0.32E-05	-0.18E-06	0.12E-04	0.89E+05	0.92E+05
79	0.837E-05	-0.14E-05	0.39E-05	0.48E-05	0.88E+05	0.91E+05
80	0.199E-05	-0.28E-05	0.11E-04	-0.55E-06	0.87E+05	0.90E+05
81	-0.137E-04	-0.36E-05	0.27E-04	-0.50E-05	0.85E+05	0.89E+05
82	-0.211E-04	-0.49E-06	0.33E-04	-0.96E-05	0.84E+05	0.88E+05
83	-0.549E-05	0.14E-05	0.17E-04	-0.85E-05	0.82E+05	0.87E+05
84	0.457E-05	0.41E-06	0.66E-05	-0.55E-05	0.81E+05	0.86E+05
85	0.643E-05	0.14E-05	0.43E-05	-0.59E-05	0.79E+05	0.85E+05
86	0.809E-05	0.47E-06	0.28E-05	-0.45E-05	0.78E+05	0.84E+05
87	0.886E-05	-0.12E-06	0.11E-05	-0.34E-05	0.76E+05	0.83E+05
88	0.967E-05	-0.27E-05	0.11E-06	-0.52E-06	0.75E+05	0.82E+05
89	0.103E-04	-0.70E-05	0.22E-07	0.40E-05	0.73E+05	0.81E+05
90	0.106E-04	-0.72E-05	-0.83E-06	0.46E-05	0.71E+05	0.81E+05
91	0.107E-04	-0.10E-04	-0.14E-05	0.79E-05	0.70E+05	0.80E+05
92	0.107E-04	-0.14E-04	-0.13E-05	0.12E-04	0.68E+05	0.79E+05
93	0.107E-04	-0.17E-04	-0.54E-06	0.15E-04	0.67E+05	0.78E+05
94	0.102E-04	-0.20E-04	-0.40E-06	0.18E-04	0.65E+05	0.77E+05
95	0.962E-05	-0.21E-04	-0.45E-06	0.19E-04	0.63E+05	0.77E+05
96	0.908E-05	-0.24E-04	0.53E-06	0.22E-04	0.62E+05	0.76E+05
97	0.875E-05	-0.27E-04	0.16E-05	0.25E-04	0.60E+05	0.75E+05
98	0.837E-05	-0.28E-04	0.19E-05	0.26E-04	0.58E+05	0.75E+05
99	0.832E-05	-0.31E-04	0.24E-05	0.29E-04	0.57E+05	0.74E+05
100	0.766E-05	-0.32E-04	0.39E-05	0.30E-04	0.55E+05	0.73E+05
101	0.690E-05	-0.32E-04	0.47E-05	0.29E-04	0.53E+05	0.73E+05
102	0.635E-05	-0.32E-04	0.51E-05	0.29E-04	0.52E+05	0.72E+05
103	0.573E-05	-0.29E-04	0.61E-05	0.27E-04	0.50E+05	0.72E+05
104	0.505E-05	-0.26E-04	0.70E-05	0.23E-04	0.48E+05	0.71E+05
105	0.364E-05	-0.25E-04	0.87E-05	0.21E-04	0.47E+05	0.71E+05
106	0.356E-05	-0.21E-04	0.90E-05	0.18E-04	0.45E+05	0.70E+05
107	0.296E-05	-0.13E-04	0.93E-05	0.99E-05	0.43E+05	0.70E+05

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
43	-0.378E-04	0.32E-04	0.35E-04	-0.37E-04	0.11E+06	0.15E+06
44	-0.262E-04	0.31E-04	0.33E-04	-0.38E-04	0.11E+06	0.14E+06
45	-0.162E-04	0.28E-04	0.31E-04	-0.36E-04	0.10E+06	0.14E+06
46	-0.804E-05	0.24E-04	0.28E-04	-0.32E-04	0.10E+06	0.14E+06
47	-0.226E-05	0.19E-04	0.25E-04	-0.26E-04	0.10E+06	0.14E+06
48	0.101E-05	0.12E-04	0.23E-04	-0.20E-04	0.10E+06	0.14E+06
49	0.222E-05	0.45E-05	0.20E-04	-0.12E-04	0.10E+06	0.13E+06
50	0.125E-05	-0.41E-05	0.18E-04	-0.27E-05	0.10E+06	0.13E+06
51	0.285E-06	-0.95E-05	0.18E-04	0.27E-05	0.10E+06	0.13E+06
52	0.602E-06	-0.70E-05	0.20E-04	0.65E-07	0.10E+06	0.13E+06
53	0.154E-05	0.16E-05	0.25E-04	-0.87E-05	0.10E+06	0.13E+06
54	0.804E-06	0.11E-04	0.29E-04	-0.19E-04	0.10E+06	0.13E+06
55	-0.182E-05	0.20E-04	0.33E-04	-0.27E-04	0.10E+06	0.12E+06
56	-0.737E-05	0.17E-04	0.35E-04	-0.25E-04	0.10E+06	0.12E+06
57	-0.145E-04	0.58E-05	0.35E-04	-0.15E-04	0.10E+06	0.12E+06
58	-0.207E-04	-0.49E-05	0.37E-04	-0.40E-05	0.10E+06	0.12E+06
59	-0.259E-04	-0.14E-04	0.38E-04	0.31E-05	0.10E+06	0.12E+06
60	-0.299E-04	-0.22E-04	0.40E-04	0.10E-04	0.10E+06	0.12E+06
61	-0.320E-04	-0.27E-04	0.41E-04	0.15E-04	0.10E+06	0.12E+06
62	-0.322E-04	-0.30E-04	0.40E-04	0.18E-04	0.10E+06	0.11E+06
63	-0.287E-04	-0.33E-04	0.36E-04	0.21E-04	0.10E+06	0.11E+06
64	-0.194E-04	-0.28E-04	0.25E-04	0.19E-04	0.10E+06	0.11E+06
65	-0.124E-04	-0.21E-04	0.16E-04	0.14E-04	0.10E+06	0.11E+06
66	-0.431E-05	-0.10E-04	0.58E-05	0.56E-05	0.10E+06	0.11E+06
67	0.151E-04	0.33E-05	-0.16E-04	-0.12E-05	0.99E+05	0.11E+06
68	0.267E-04	0.15E-04	-0.30E-04	-0.82E-05	0.99E+05	0.11E+06
69	0.352E-04	0.26E-04	-0.41E-04	-0.15E-04	0.98E+05	0.10E+06
70	0.417E-04	0.32E-04	-0.48E-04	-0.19E-04	0.97E+05	0.10E+06
71	0.420E-04	0.35E-04	-0.48E-04	-0.21E-04	0.97E+05	0.10E+06
72	0.402E-04	0.37E-04	-0.45E-04	-0.23E-04	0.96E+05	0.10E+06
73	0.441E-04	0.15E-04	-0.40E-04	-0.21E-06	0.95E+05	0.99E+05
74	0.403E-04	0.23E-05	-0.31E-04	0.12E-04	0.94E+05	0.97E+05
75	0.308E-04	0.57E-05	-0.22E-04	0.65E-05	0.93E+05	0.96E+05
76	0.260E-04	-0.28E-05	-0.14E-04	0.14E-04	0.92E+05	0.95E+05
77	0.200E-04	-0.62E-05	-0.64E-05	0.18E-04	0.91E+05	0.93E+05
78	0.131E-04	-0.32E-05	-0.18E-06	0.12E-04	0.89E+05	0.92E+05
79	0.837E-05	-0.14E-05	0.39E-05	0.48E-05	0.88E+05	0.91E+05
80	0.199E-05	-0.28E-05	0.11E-04	-0.55E-06	0.87E+05	0.90E+05
81	-0.137E-04	-0.36E-05	0.27E-04	-0.50E-05	0.85E+05	0.89E+05
82	-0.211E-04	-0.49E-06	0.33E-04	-0.96E-05	0.84E+05	0.88E+05
83	-0.549E-05	0.14E-05	0.17E-04	-0.85E-05	0.82E+05	0.87E+05
84	0.457E-05	0.41E-06	0.66E-05	-0.55E-05	0.81E+05	0.86E+05
85	0.643E-05	0.14E-05	0.43E-05	-0.59E-05	0.79E+05	0.85E+05
86	0.809E-05	0.47E-06	0.28E-05	-0.45E-05	0.78E+05	0.84E+05
87	0.886E-05	-0.12E-06	0.11E-05	-0.34E-05	0.76E+05	0.83E+05
88	0.967E-05	-0.27E-05	0.11E-06	-0.52E-06	0.75E+05	0.82E+05
89	0.103E-04	-0.70E-05	0.22E-07	0.40E-05	0.73E+05	0.81E+05
90	0.106E-04	-0.72E-05	-0.83E-06	0.46E-05	0.71E+05	0.81E+05
91	0.107E-04	-0.10E-04	-0.14E-05	0.79E-05	0.70E+05	0.80E+05
92	0.107E-04	-0.14E-04	-0.13E-05	0.12E-04	0.68E+05	0.79E+05
93	0.107E-04	-0.17E-04	-0.54E-06	0.15E-04	0.67E+05	0.78E+05
94	0.102E-04	-0.20E-04	-0.40E-06	0.18E-04	0.65E+05	0.77E+05
95	0.962E-05	-0.21E-04	-0.45E-06	0.19E-04	0.63E+05	0.77E+05
96	0.908E-05	-0.24E-04	0.53E-06	0.22E-04	0.62E+05	0.76E+05
97	0.875E-05	-0.27E-04	0.16E-05	0.25E-04	0.60E+05	0.75E+05
98	0.837E-05	-0.28E-04	0.19E-05	0.26E-04	0.58E+05	0.75E+05
99	0.832E-05	-0.31E-04	0.24E-05	0.29E-04	0.57E+05	0.74E+05
100	0.766E-05	-0.32E-04	0.39E-05	0.30E-04	0.55E+05	0.73E+05
101	0.690E-05	-0.32E-04	0.47E-05	0.29E-04	0.53E+05	0.73E+05
102	0.635E-05	-0.32E-04	0.51E-05	0.29E-04	0.52E+05	0.72E+05
103	0.573E-05	-0.29E-04	0.61E-05	0.27E-04	0.50E+05	0.72E+05
104	0.505E-05	-0.26E-04	0.70E-05	0.23E-04	0.48E+05	0.71E+05
105	0.364E-05	-0.25E-04	0.87E-05	0.21E-04	0.47E+05	0.71E+05
106	0.356E-05	-0.21E-04	0.90E-05	0.18E-04	0.45E+05	0.70E+05
107	0.246E-05	-0.13E-04	0.93E-05	0.99E-05	0.43E+05	0.70E+05

Table B-2 DKP for the large-scale cluster (without corrections for position errors). This data is for a natural coordinate system.

Table B-2 DKP for the large-scale cluster (without corrections for position errors). This data is for a natural coordinate system.

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
43	-0.188E+03	0.50E+00	0.44E-04	-0.26E-04
44	-0.187E+03	0.51E+00	0.42E-04	-0.28E-04
45	-0.187E+03	0.51E+00	0.39E-04	-0.28E-04
46	-0.186E+03	0.51E+00	0.34E-04	-0.25E-04
47	-0.185E+03	0.51E+00	0.30E-04	-0.21E-04
48	-0.185E+03	0.50E+00	0.26E-04	-0.15E-04
49	-0.184E+03	0.50E+00	0.21E-04	-0.87E-05
50	-0.183E+03	0.49E+00	0.18E-04	-0.86E-06
51	-0.183E+03	0.48E+00	0.17E-04	0.43E-05
52	-0.184E+03	0.47E+00	0.20E-04	0.28E-05
53	-0.186E+03	0.47E+00	0.26E-04	-0.32E-05
54	-0.189E+03	0.46E+00	0.34E-04	-0.91E-05
55	-0.191E+03	0.45E+00	0.41E-04	-0.13E-04
56	-0.192E+03	0.45E+00	0.42E-04	-0.96E-05
57	-0.191E+03	0.44E+00	0.38E-04	-0.66E-06
58	-0.190E+03	0.43E+00	0.36E-04	0.84E-05
59	-0.190E+03	0.42E+00	0.35E-04	0.16E-04
60	-0.191E+03	0.41E+00	0.34E-04	0.24E-04
61	-0.191E+03	0.41E+00	0.32E-04	0.30E-04
62	-0.193E+03	0.40E+00	0.28E-04	0.33E-04
63	-0.194E+03	0.40E+00	0.22E-04	0.35E-04
64	-0.196E+03	0.40E+00	0.12E-04	0.29E-04
65	-0.198E+03	0.40E+00	0.53E-05	0.21E-04
66	-0.200E+03	0.40E+00	0.90E-06	0.80E-05
67	-0.202E+03	0.40E+00	-0.11E-04	-0.12E-04
68	-0.204E+03	0.41E+00	-0.14E-04	-0.28E-04
69	-0.206E+03	0.41E+00	-0.12E-04	-0.42E-04
70	-0.208E+03	0.42E+00	-0.10E-04	-0.50E-04
71	-0.211E+03	0.43E+00	-0.46E-05	-0.52E-04
72	-0.213E+03	0.44E+00	0.18E-05	-0.50E-04
73	-0.215E+03	0.45E+00	-0.13E-04	-0.38E-04
74	-0.218E+03	0.47E+00	-0.19E-04	-0.27E-04
75	-0.220E+03	0.48E+00	-0.10E-04	-0.20E-04
76	-0.222E+03	0.49E+00	-0.16E-04	-0.12E-04
77	-0.223E+03	0.50E+00	-0.18E-04	-0.53E-05
78	-0.225E+03	0.50E+00	-0.12E-04	-0.26E-06
79	-0.229E+03	0.49E+00	-0.52E-05	0.33E-05
80	-0.232E+03	0.48E+00	-0.23E-05	0.11E-04
81	-0.236E+03	0.47E+00	-0.52E-05	0.27E-04
82	-0.237E+03	0.48E+00	-0.52E-05	0.34E-04
83	-0.237E+03	0.49E+00	0.61E-06	0.19E-04
84	-0.238E+03	0.49E+00	0.21E-05	0.83E-05
85	-0.239E+03	0.50E+00	0.33E-05	0.66E-05
86	-0.240E+03	0.50E+00	0.25E-05	0.46E-05
87	-0.240E+03	0.50E+00	0.24E-05	0.27E-05
88	-0.241E+03	0.50E+00	0.38E-06	0.37E-06
89	-0.242E+03	0.50E+00	-0.34E-05	-0.22E-05
90	-0.243E+03	0.50E+00	-0.32E-05	-0.33E-05
91	-0.243E+03	0.50E+00	-0.55E-05	-0.59E-05
92	-0.244E+03	0.50E+00	-0.84E-05	-0.82E-05
93	-0.245E+03	0.50E+00	-0.12E-04	-0.10E-04
94	-0.245E+03	0.50E+00	-0.14E-04	-0.12E-04
95	-0.246E+03	0.50E+00	-0.14E-04	-0.13E-04
96	-0.247E+03	0.50E+00	-0.16E-04	-0.15E-04
97	-0.248E+03	0.49E+00	-0.19E-04	-0.17E-04
98	-0.249E+03	0.49E+00	-0.19E-04	-0.18E-04
99	-0.249E+03	0.49E+00	-0.21E-04	-0.20E-04
100	-0.250E+03	0.49E+00	-0.22E-04	-0.21E-04
101	-0.251E+03	0.49E+00	-0.22E-04	-0.20E-04
102	-0.252E+03	0.49E+00	-0.21E-04	-0.21E-04
103	-0.253E+03	0.50E+00	-0.20E-04	-0.19E-04
104	-0.254E+03	0.50E+00	-0.18E-04	-0.16E-04
105	-0.255E+03	0.51E+00	-0.18E-04	-0.14E-04
106	-0.256E+03	0.51E+00	-0.16E-04	-0.12E-04
107	-0.258E+03	0.53E+00	-0.13E-04	-0.52E-05

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
43	-0.188E+03	0.50E+00	0.44E-04	-0.26E-04
44	-0.187E+03	0.51E+00	0.42E-04	-0.28E-04
45	-0.187E+03	0.51E+00	0.39E-04	-0.28E-04
46	-0.186E+03	0.51E+00	0.34E-04	-0.25E-04
47	-0.185E+03	0.51E+00	0.30E-04	-0.21E-04
48	-0.185E+03	0.50E+00	0.26E-04	-0.15E-04
49	-0.184E+03	0.50E+00	0.21E-04	-0.87E-05
50	-0.183E+03	0.49E+00	0.18E-04	-0.86E-06
51	-0.183E+03	0.48E+00	0.17E-04	0.43E-05
52	-0.184E+03	0.47E+00	0.20E-04	0.28E-05
53	-0.186E+03	0.47E+00	0.26E-04	-0.32E-05
54	-0.189E+03	0.46E+00	0.34E-04	-0.91E-05
55	-0.191E+03	0.45E+00	0.41E-04	-0.13E-04
56	-0.192E+03	0.45E+00	0.42E-04	-0.96E-05
57	-0.191E+03	0.44E+00	0.38E-04	-0.66E-06
58	-0.190E+03	0.43E+00	0.36E-04	0.84E-05
59	-0.190E+03	0.42E+00	0.35E-04	0.16E-04
60	-0.191E+03	0.41E+00	0.34E-04	0.24E-04
61	-0.191E+03	0.41E+00	0.32E-04	0.30E-04
62	-0.193E+03	0.40E+00	0.28E-04	0.33E-04
63	-0.194E+03	0.40E+00	0.22E-04	0.35E-04
64	-0.196E+03	0.40E+00	0.12E-04	0.29E-04
65	-0.198E+03	0.40E+00	0.53E-05	0.21E-04
66	-0.200E+03	0.40E+00	0.90E-06	0.80E-05
67	-0.202E+03	0.40E+00	-0.11E-04	-0.12E-04
68	-0.204E+03	0.41E+00	-0.14E-04	-0.28E-04
69	-0.206E+03	0.41E+00	-0.12E-04	-0.42E-04
70	-0.208E+03	0.42E+00	-0.10E-04	-0.50E-04
71	-0.211E+03	0.43E+00	-0.46E-05	-0.52E-04
72	-0.213E+03	0.44E+00	0.18E-05	-0.50E-04
73	-0.215E+03	0.45E+00	-0.13E-04	-0.38E-04
74	-0.218E+03	0.47E+00	-0.19E-04	-0.27E-04
75	-0.220E+03	0.48E+00	-0.10E-04	-0.20E-04
76	-0.222E+03	0.49E+00	-0.16E-04	-0.12E-04
77	-0.223E+03	0.50E+00	-0.18E-04	-0.53E-05
78	-0.225E+03	0.50E+00	-0.12E-04	-0.26E-06
79	-0.229E+03	0.49E+00	-0.52E-05	0.33E-05
80	-0.232E+03	0.48E+00	-0.23E-05	0.11E-04
81	-0.236E+03	0.47E+00	-0.52E-05	0.27E-04
82	-0.237E+03	0.48E+00	-0.52E-05	0.34E-04
83	-0.237E+03	0.49E+00	0.61E-06	0.19E-04
84	-0.238E+03	0.49E+00	0.21E-05	0.83E-05
85	-0.239E+03	0.50E+00	0.33E-05	0.66E-05
86	-0.240E+03	0.50E+00	0.25E-05	0.46E-05
87	-0.240E+03	0.50E+00	0.24E-05	0.27E-05
88	-0.241E+03	0.50E+00	0.38E-06	0.37E-06
89	-0.242E+03	0.50E+00	-0.34E-05	-0.22E-05
90	-0.243E+03	0.50E+00	-0.32E-05	-0.33E-05
91	-0.243E+03	0.50E+00	-0.55E-05	-0.59E-05
92	-0.244E+03	0.50E+00	-0.84E-05	-0.82E-05
93	-0.245E+03	0.50E+00	-0.12E-04	-0.10E-04
94	-0.245E+03	0.50E+00	-0.14E-04	-0.12E-04
95	-0.246E+03	0.50E+00	-0.14E-04	-0.13E-04
96	-0.247E+03	0.50E+00	-0.16E-04	-0.15E-04
97	-0.248E+03	0.49E+00	-0.19E-04	-0.17E-04
98	-0.249E+03	0.49E+00	-0.19E-04	-0.18E-04
99	-0.249E+03	0.49E+00	-0.21E-04	-0.20E-04
100	-0.250E+03	0.49E+00	-0.22E-04	-0.21E-04
101	-0.251E+03	0.49E+00	-0.22E-04	-0.20E-04
102	-0.252E+03	0.49E+00	-0.21E-04	-0.21E-04
103	-0.253E+03	0.50E+00	-0.20E-04	-0.19E-04
104	-0.254E+03	0.50E+00	-0.18E-04	-0.16E-04
105	-0.255E+03	0.51E+00	-0.18E-04	-0.14E-04
106	-0.256E+03	0.51E+00	-0.16E-04	-0.12E-04
107	-0.258E+03	0.53E+00	-0.13E-04	-0.52E-05

Table B-3 Potential vorticity equation components for the large-scale cluster (without corrections for position errors).

Table B-4 DKP and the location of the center of mass for the large-scale cluster (with corrections for position errors). This data is for a geographic coordinate system.

POT. VORT. EGN. COMP. 5

HOUR	TIME DER	DIV*VOR	RES
44	-0.469E-09	-0.29E-08	-0.34E-08
45	-0.940E-09	-0.18E-08	-0.27E-08
46	-0.136E-08	-0.84E-09	-0.22E-08
47	-0.168E-08	-0.22E-09	-0.19E-08
48	-0.198E-08	0.93E-10	-0.19E-08
49	-0.227E-08	0.19E-09	-0.21E-08
50	-0.196E-08	0.95E-10	-0.19E-08
51	-0.417E-09	0.20E-10	-0.40E-09
52	0.153E-08	0.44E-10	0.16E-08
53	0.255E-08	0.12E-09	0.27E-08
54	0.251E-08	0.73E-10	0.26E-08
55	0.786E-09	-0.18E-09	0.61E-09
56	-0.195E-08	-0.71E-09	-0.27E-08
57	-0.308E-08	-0.12E-08	-0.43E-08
58	-0.269E-08	-0.15E-08	-0.42E-08
59	-0.233E-08	-0.17E-08	-0.40E-08
60	-0.194E-08	-0.17E-08	-0.37E-08
61	-0.122E-08	-0.17E-08	-0.29E-08
62	-0.775E-09	-0.16E-08	-0.24E-08
63	0.309E-09	-0.13E-08	-0.10E-08
64	0.165E-08	-0.10E-08	0.65E-09
65	0.249E-08	-0.72E-09	0.18E-08
66	0.337E-08	-0.30E-09	0.31E-08
67	0.345E-08	0.12E-08	0.47E-08
68	0.312E-08	0.25E-08	0.56E-08
69	0.240E-08	0.37E-08	0.61E-08
70	0.134E-08	0.46E-08	0.60E-08
71	0.692E-09	0.48E-08	0.55E-08
72	-0.281E-08	0.47E-08	0.19E-08
73	-0.485E-08	0.42E-08	-0.66E-09
74	-0.134E-08	0.33E-08	0.19E-08
75	-0.715E-09	0.26E-08	0.19E-08
76	-0.166E-08	0.20E-08	0.32E-09
77	-0.568E-10	0.15E-08	0.14E-08
78	0.660E-09	0.10E-08	0.17E-08
79	0.456E-10	0.65E-09	0.70E-09
80	-0.300E-09	0.15E-09	-0.15E-09
81	0.317E-09	-0.10E-08	-0.72E-09
82	0.682E-09	-0.17E-08	-0.97E-09
83	0.120E-09	-0.44E-09	-0.32E-09
84	0.229E-11	0.36E-09	0.37E-09
85	0.406E-11	0.52E-09	0.52E-09
86	-0.223E-09	0.64E-09	0.42E-09
87	-0.443E-09	0.70E-09	0.25E-09
88	-0.964E-09	0.74E-09	-0.23E-09
89	-0.636E-09	0.74E-09	0.10E-09
90	-0.456E-09	0.76E-09	0.30E-09
91	-0.929E-09	0.74E-09	-0.19E-09
92	-0.100E-08	0.69E-09	-0.31E-09
93	-0.912E-09	0.66E-09	-0.26E-09
94	-0.493E-09	0.60E-09	0.10E-09
95	-0.487E-09	0.56E-09	0.68E-10
96	-0.641E-09	0.50E-09	-0.34E-09
97	-0.593E-09	0.45E-09	-0.14E-09
98	-0.523E-09	0.42E-09	-0.10E-09
99	-0.570E-09	0.40E-09	-0.17E-09
100	-0.125E-09	0.36E-09	0.23E-09
101	0.808E-10	0.32E-09	0.41E-09
102	0.336E-09	0.30E-09	0.64E-09
103	0.765E-09	0.26E-09	0.10E-08
104	0.580E-09	0.27E-09	0.85E-09
105	0.709E-09	0.20E-09	0.90E-09
106	0.165E-08	0.21E-09	0.19E-08

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
43	-0.387E-04	0.32E-04	0.36E-04	-0.38E-04	0.11E+06	0.15E+06
44	-0.270E-04	0.32E-04	0.34E-04	-0.39E-04	0.11E+06	0.14E+06
45	-0.168E-04	0.29E-04	0.32E-04	-0.37E-04	0.10E+06	0.14E+06
46	-0.836E-05	0.25E-04	0.29E-04	-0.33E-04	0.10E+06	0.14E+06
47	-0.237E-05	0.20E-04	0.26E-04	-0.27E-04	0.10E+06	0.14E+06
48	0.106E-05	0.13E-04	0.24E-04	-0.20E-04	0.10E+06	0.14E+06
49	0.233E-05	0.48E-05	0.21E-04	-0.12E-04	0.10E+06	0.13E+06
50	0.132E-05	-0.43E-05	0.19E-04	-0.29E-05	0.10E+06	0.13E+06
51	0.301E-06	-0.10E-04	0.19E-04	0.29E-05	0.10E+06	0.13E+06
52	0.638E-06	-0.75E-05	0.22E-04	0.68E-07	0.10E+06	0.13E+06
53	0.164E-05	0.17E-05	0.27E-04	-0.93E-05	0.10E+06	0.13E+06
54	0.862E-06	0.12E-04	0.32E-04	-0.20E-04	0.10E+06	0.13E+06
55	-0.198E-05	0.21E-04	0.36E-04	-0.30E-04	0.10E+06	0.12E+06
56	-0.813E-05	0.19E-04	0.36E-04	-0.28E-04	0.10E+06	0.12E+06
57	-0.163E-04	0.65E-05	0.40E-04	-0.16E-04	0.10E+06	0.12E+06
58	-0.239E-04	-0.57E-05	0.42E-04	-0.53E-05	0.10E+06	0.12E+06
59	-0.310E-04	-0.16E-04	0.46E-04	0.37E-05	0.10E+06	0.12E+06
60	-0.378E-04	-0.27E-04	0.51E-04	0.13E-04	0.10E+06	0.12E+06
61	-0.438E-04	-0.37E-04	0.56E-04	0.21E-04	0.10E+06	0.12E+06
62	-0.489E-04	-0.46E-04	0.61E-04	0.27E-04	0.10E+06	0.11E+06
63	-0.503E-04	-0.58E-04	0.62E-04	0.37E-04	0.10E+06	0.11E+06
64	-0.400E-04	-0.58E-04	0.51E-04	0.39E-04	0.10E+06	0.11E+06
65	-0.282E-04	-0.48E-04	0.37E-04	0.32E-04	0.10E+06	0.11E+06
66	-0.111E-04	-0.26E-04	0.15E-04	0.14E-04	0.10E+06	0.11E+06
67	0.374E-04	0.81E-05	-0.41E-04	-0.30E-05	0.99E+05	0.11E+06
68	0.529E-04	0.29E-04	-0.60E-04	-0.16E-04	0.99E+05	0.11E+06
69	0.595E-04	0.44E-04	-0.69E-04	-0.26E-04	0.98E+05	0.10E+06
70	0.601E-04	0.46E-04	-0.69E-04	-0.27E-04	0.97E+05	0.10E+06
71	0.545E-04	0.46E-04	-0.62E-04	-0.27E-04	0.97E+05	0.10E+06
72	0.485E-04	0.45E-04	-0.54E-04	-0.27E-04	0.96E+05	0.10E+06
73	0.509E-04	0.18E-04	-0.46E-04	-0.25E-06	0.95E+05	0.99E+05
74	0.446E-04	0.25E-05	-0.34E-04	0.13E-04	0.94E+05	0.97E+05
75	0.334E-04	0.62E-05	-0.24E-04	0.71E-05	0.93E+05	0.96E+05
76	0.279E-04	-0.30E-05	-0.15E-04	0.15E-04	0.92E+05	0.95E+05
77	0.212E-04	-0.66E-05	-0.67E-05	0.19E-04	0.91E+05	0.93E+05
78	0.139E-04	-0.34E-05	-0.19E-06	0.13E-04	0.89E+05	0.92E+05
79	0.882E-05	-0.15E-05	0.41E-05	0.50E-05	0.88E+05	0.91E+05
80	0.209E-05	-0.30E-05	0.11E-04	-0.58E-06	0.87E+05	0.90E+05
81	-0.145E-04	-0.38E-05	0.29E-04	-0.53E-05	0.85E+05	0.89E+05
82	-0.227E-04	-0.53E-06	0.36E-04	-0.10E-04	0.84E+05	0.88E+05
83	-0.597E-05	0.15E-05	0.18E-04	-0.93E-05	0.82E+05	0.87E+05
84	0.498E-05	0.45E-06	0.72E-05	-0.59E-05	0.81E+05	0.86E+05
85	0.700E-05	0.16E-05	0.47E-05	-0.65E-05	0.79E+05	0.85E+05
86	0.680E-05	0.52E-06	0.30E-05	-0.46E-05	0.78E+05	0.84E+05
87	0.962E-05	-0.13E-06	0.12E-05	-0.37E-05	0.76E+05	0.83E+05
88	0.105E-04	-0.29E-05	0.12E-06	-0.56E-06	0.75E+05	0.82E+05
89	0.111E-04	-0.76E-05	0.23E-07	0.43E-05	0.73E+05	0.81E+05
90	0.114E-04	-0.78E-05	-0.90E-06	0.49E-05	0.71E+05	0.81E+05
91	0.115E-04	-0.11E-04	-0.15E-05	0.85E-05	0.70E+05	0.80E+05
92	0.114E-04	-0.15E-04	-0.14E-05	0.12E-04	0.68E+05	0.79E+05
93	0.114E-04	-0.19E-04	-0.57E-06	0.16E-04	0.67E+05	0.78E+05
94	0.108E-04	-0.22E-04	-0.42E-06	0.19E-04	0.65E+05	0.77E+05
95	0.102E-04	-0.22E-04	-0.47E-06	0.20E-04	0.63E+05	0.77E+05
96	0.957E-05	-0.25E-04	0.55E-06	0.23E-04	0.62E+05	0.76E+05
97	0.919E-05	-0.28E-04	0.17E-05	0.26E-04	0.60E+05	0.75E+05
98	0.877E-05	-0.29E-04	0.20E-05	0.27E-04	0.58E+05	0.75E+05
99	0.869E-05	-0.32E-04	0.26E-05	0.30E-04	0.57E+05	0.74E+05
100	0.798E-05	-0.34E-04	0.41E-05	0.31E-04	0.55E+05	0.73E+05
101	0.717E-05	-0.33E-04	0.49E-05	0.30E-04	0.53E+05	0.73E+05
102	0.659E-05	-0.33E-04	0.53E-05	0.30E-04	0.52E+05	0.72E+05
103	0.593E-05	-0.30E-04	0.63E-05	0.27E-04	0.50E+05	0.72E+05
104	0.523E-05	-0.27E-04	0.72E-05	0.24E-04	0.48E+05	0.71E+05
105	0.376E-05	-0.26E-04	0.84E-05	0.22E-04	0.47E+05	0.71E+05
106	0.367E-05	-0.22E-04	0.93E-05	0.18E-04	0.45E+05	0.70E+05
107	0.306E-05	-0.14E-04	0.96E-05	0.10E-04	0.43E+05	0.70E+05

Table B-4 DKP and the location of the center of mass for the large-scale cluster (with corrections for position errors). This data is for a geographic coordinate system.

Table B-5 DKP for the large-scale cluster (with corrections for position errors). This data is for a natural coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
43	-0.387E-04	0.32E-04	0.36E-04	-0.38E-04	0.11E+06	0.15E+06
44	-0.270E-04	0.32E-04	0.34E-04	-0.39E-04	0.11E+06	0.14E+06
45	-0.168E-04	0.29E-04	0.32E-04	-0.37E-04	0.10E+06	0.14E+06
46	-0.836E-05	0.25E-04	0.29E-04	-0.33E-04	0.10E+06	0.14E+06
47	-0.237E-05	0.20E-04	0.26E-04	-0.27E-04	0.10E+06	0.14E+06
48	0.106E-05	0.13E-04	0.24E-04	-0.20E-04	0.10E+06	0.14E+06
49	0.233E-05	0.48E-05	0.21E-04	-0.12E-04	0.10E+06	0.13E+06
50	0.132E-05	-0.43E-05	0.19E-04	-0.29E-05	0.10E+06	0.13E+06
51	0.301E-06	-0.10E-04	0.19E-04	0.29E-05	0.10E+06	0.13E+06
52	0.638E-06	-0.75E-05	0.22E-04	0.68E-07	0.10E+06	0.13E+06
53	0.164E-05	0.17E-05	0.27E-04	-0.93E-05	0.10E+06	0.13E+06
54	0.862E-06	0.12E-04	0.32E-04	-0.20E-04	0.10E+06	0.13E+06
55	-0.198E-05	0.21E-04	0.36E-04	-0.30E-04	0.10E+06	0.12E+06
56	-0.813E-05	0.19E-04	0.36E-04	-0.28E-04	0.10E+06	0.12E+06
57	-0.163E-04	0.65E-05	0.40E-04	-0.16E-04	0.10E+06	0.12E+06
58	-0.239E-04	-0.57E-05	0.42E-04	-0.53E-05	0.10E+06	0.12E+06
59	-0.310E-04	-0.16E-04	0.46E-04	0.37E-05	0.10E+06	0.12E+06
60	-0.378E-04	-0.27E-04	0.51E-04	0.13E-04	0.10E+06	0.12E+06
61	-0.438E-04	-0.37E-04	0.56E-04	0.21E-04	0.10E+06	0.12E+06
62	-0.489E-04	-0.46E-04	0.61E-04	0.27E-04	0.10E+06	0.11E+06
63	-0.503E-04	-0.58E-04	0.62E-04	0.37E-04	0.10E+06	0.11E+06
64	-0.400E-04	-0.58E-04	0.51E-04	0.39E-04	0.10E+06	0.11E+06
65	-0.282E-04	-0.48E-04	0.37E-04	0.32E-04	0.10E+06	0.11E+06
66	-0.111E-04	-0.26E-04	0.15E-04	0.14E-04	0.10E+06	0.11E+06
67	0.374E-04	0.81E-05	-0.41E-04	-0.30E-05	0.99E+05	0.11E+06
68	0.529E-04	0.29E-04	-0.60E-04	-0.16E-04	0.99E+05	0.11E+06
69	0.555E-04	0.44E-04	-0.69E-04	-0.26E-04	0.98E+05	0.10E+06
70	0.601E-04	0.46E-04	-0.69E-04	-0.27E-04	0.97E+05	0.10E+06
71	0.545E-04	0.46E-04	-0.62E-04	-0.27E-04	0.97E+05	0.10E+06
72	0.485E-04	0.45E-04	-0.54E-04	-0.27E-04	0.96E+05	0.10E+06
73	0.509E-04	0.18E-04	-0.46E-04	-0.25E-06	0.95E+05	0.99E+05
74	0.446E-04	0.25E-05	-0.34E-04	0.13E-04	0.94E+05	0.97E+05
75	0.334E-04	0.62E-05	-0.24E-04	0.71E-05	0.93E+05	0.96E+05
76	0.279E-04	-0.30E-05	-0.15E-04	0.15E-04	0.92E+05	0.95E+05
77	0.212E-04	-0.66E-05	-0.67E-05	0.19E-04	0.91E+05	0.93E+05
78	0.139E-04	-0.34E-05	-0.19E-06	0.13E-04	0.89E+05	0.92E+05
79	0.882E-05	-0.15E-05	0.41E-05	0.50E-05	0.88E+05	0.91E+05
80	0.209E-05	-0.30E-05	0.11E-04	-0.58E-06	0.87E+05	0.90E+05
81	-0.145E-04	-0.38E-05	0.29E-04	-0.53E-05	0.85E+05	0.89E+05
82	-0.227E-04	-0.53E-06	0.36E-04	-0.10E-04	0.84E+05	0.88E+05
83	-0.597E-05	0.15E-05	0.18E-04	-0.93E-05	0.82E+05	0.87E+05
84	0.498E-05	0.45E-06	0.72E-05	-0.59E-05	0.81E+05	0.86E+05
85	0.700E-05	0.16E-05	0.47E-05	-0.65E-05	0.79E+05	0.85E+05
86	0.680E-05	0.52E-06	0.30E-05	-0.46E-05	0.78E+05	0.84E+05
87	0.962E-05	-0.13E-06	0.12E-05	-0.37E-05	0.76E+05	0.83E+05
88	0.105E-04	-0.29E-05	0.12E-06	-0.56E-06	0.75E+05	0.82E+05
89	0.111E-04	-0.76E-05	0.23E-07	0.43E-05	0.73E+05	0.81E+05
90	0.114E-04	-0.78E-05	-0.90E-06	0.49E-05	0.71E+05	0.81E+05
91	0.115E-04	-0.11E-04	-0.15E-05	0.85E-05	0.70E+05	0.80E+05
92	0.114E-04	-0.15E-04	-0.14E-05	0.12E-04	0.68E+05	0.79E+05
93	0.114E-04	-0.19E-04	-0.57E-06	0.16E-04	0.67E+05	0.78E+05
94	0.108E-04	-0.22E-04	-0.42E-06	0.19E-04	0.65E+05	0.77E+05
95	0.102E-04	-0.22E-04	-0.47E-06	0.20E-04	0.63E+05	0.77E+05
96	0.957E-05	-0.25E-04	0.55E-06	0.23E-04	0.62E+05	0.76E+05
97	0.919E-05	-0.28E-04	0.17E-05	0.26E-04	0.60E+05	0.75E+05
98	0.877E-05	-0.29E-04	0.20E-05	0.27E-04	0.58E+05	0.75E+05
99	0.869E-05	-0.32E-04	0.26E-05	0.30E-04	0.57E+05	0.74E+05
100	0.798E-05	-0.34E-04	0.41E-05	0.31E-04	0.55E+05	0.73E+05
101	0.717E-05	-0.33E-04	0.49E-05	0.30E-04	0.53E+05	0.73E+05
102	0.659E-05	-0.33E-04	0.53E-05	0.30E-04	0.52E+05	0.72E+05
103	0.593E-05	-0.30E-04	0.63E-05	0.27E-04	0.50E+05	0.72E+05
104	0.523E-05	-0.27E-04	0.72E-05	0.24E-04	0.48E+05	0.71E+05
105	0.376E-05	-0.26E-04	0.89E-05	0.22E-04	0.47E+05	0.71E+05
106	0.367E-05	-0.22E-04	0.93E-05	0.18E-04	0.45E+05	0.70E+05
107	0.306E-05	-0.14E-04	0.96E-05	0.10E-04	0.43E+05	0.70E+05

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
43	-0.188E+03	0.50E+00	0.45E-04	-0.26E-04
44	-0.187E+03	0.51E+00	0.43E-04	-0.29E-04
45	-0.187E+03	0.51E+00	0.40E-04	-0.29E-04

Table B-6 Potential vorticity equation components for the large-scale cluster (with corrections for position errors).

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
43	-0.188E+03	0.50E+00	0.45E-04	-0.26E-04
44	-0.187E+03	0.51E+00	0.43E-04	-0.29E-04
45	-0.187E+03	0.51E+00	0.40E-04	-0.29E-04
46	-0.186E+03	0.51E+00	0.36E-04	-0.26E-04
47	-0.185E+03	0.51E+00	0.31E-04	-0.22E-04
48	-0.185E+03	0.50E+00	0.27E-04	-0.16E-04
49	-0.184E+03	0.50E+00	0.23E-04	-0.91E-05
50	-0.183E+03	0.49E+00	0.19E-04	-0.91E-06
51	-0.183E+03	0.48E+00	0.18E-04	0.46E-05
52	-0.184E+03	0.47E+00	0.21E-04	0.29E-05
53	-0.186E+03	0.47E+00	0.28E-04	-0.34E-05
54	-0.189E+03	0.46E+00	0.36E-04	-0.98E-05
55	-0.191E+03	0.45E+00	0.45E-04	-0.14E-04
56	-0.192E+03	0.45E+00	0.46E-04	-0.11E-04
57	-0.191E+03	0.44E+00	0.43E-04	-0.75E-06
58	-0.190E+03	0.43E+00	0.41E-04	0.97E-05
59	-0.190E+03	0.42E+00	0.42E-04	0.19E-04
60	-0.191E+03	0.41E+00	0.43E-04	0.30E-04
61	-0.191E+03	0.41E+00	0.43E-04	0.41E-04
62	-0.193E+03	0.40E+00	0.43E-04	0.51E-04
63	-0.194E+03	0.40E+00	0.38E-04	0.62E-04
64	-0.196E+03	0.40E+00	0.24E-04	0.60E-04
65	-0.198E+03	0.40E+00	0.12E-04	0.47E-04
66	-0.200E+03	0.40E+00	0.23E-05	0.21E-04
67	-0.202E+03	0.40E+00	-0.27E-04	-0.30E-04
68	-0.204E+03	0.41E+00	-0.28E-04	-0.56E-04
69	-0.206E+03	0.41E+00	-0.21E-04	-0.70E-04
70	-0.208E+03	0.42E+00	-0.15E-04	-0.72E-04
71	-0.211E+03	0.43E+00	-0.60E-05	-0.68E-04
72	-0.213E+03	0.44E+00	0.22E-05	-0.61E-04
73	-0.215E+03	0.45E+00	-0.15E-04	-0.44E-04
74	-0.218E+03	0.47E+00	-0.21E-04	-0.30E-04
75	-0.220E+03	0.48E+00	-0.11E-04	-0.22E-04
76	-0.222E+03	0.49E+00	-0.17E-04	-0.13E-04
77	-0.223E+03	0.50E+00	-0.19E-04	-0.56E-05
78	-0.225E+03	0.50E+00	-0.13E-04	-0.27E-06
79	-0.229E+03	0.49E+00	-0.55E-05	0.35E-05
80	-0.232E+03	0.48E+00	-0.24E-05	0.11E-04
81	-0.236E+03	0.47E+00	-0.55E-05	0.29E-04
82	-0.237E+03	0.48E+00	-0.56E-05	0.37E-04
83	-0.237E+03	0.49E+00	0.67E-06	0.21E-04
84	-0.238E+03	0.49E+00	0.23E-05	0.90E-05
85	-0.239E+03	0.50E+00	0.36E-05	0.72E-05
86	-0.240E+03	0.50E+00	0.27E-05	0.50E-05
87	-0.240E+03	0.50E+00	0.26E-05	0.29E-05
88	-0.241E+03	0.50E+00	0.41E-06	0.40E-06
89	-0.242E+03	0.50E+00	-0.36E-05	-0.24E-05
90	-0.243E+03	0.50E+00	-0.35E-05	-0.36E-05
91	-0.243E+03	0.50E+00	-0.59E-05	-0.63E-05
92	-0.244E+03	0.50E+00	-0.90E-05	-0.87E-05
93	-0.245E+03	0.50E+00	-0.12E-04	-0.11E-04
94	-0.245E+03	0.50E+00	-0.14E-04	-0.13E-04
95	-0.246E+03	0.50E+00	-0.14E-04	-0.14E-04
96	-0.247E+03	0.50E+00	-0.17E-04	-0.16E-04
97	-0.248E+03	0.49E+00	-0.19E-04	-0.17E-04
98	-0.249E+03	0.49E+00	-0.20E-04	-0.19E-04
99	-0.249E+03	0.49E+00	-0.22E-04	-0.21E-04
100	-0.250E+03	0.49E+00	-0.23E-04	-0.21E-04
101	-0.251E+03	0.49E+00	-0.22E-04	-0.21E-04
102	-0.252E+03	0.49E+00	-0.22E-04	-0.21E-04
103	-0.253E+03	0.50E+00	-0.20E-04	-0.19E-04
104	-0.254E+03	0.50E+00	-0.19E-04	-0.17E-04
105	-0.255E+03	0.51E+00	-0.19E-04	-0.15E-04
106	-0.256E+03	0.51E+00	-0.17E-04	-0.12E-04
107	-0.258E+03	0.53E+00	-0.13E-04	-0.53E-05

POT. VORT. EQN. COMP. S

HOUR	TIME DER	DIV*VOR	RES
44	-0.437E-09	-0.30E-08	-0.35E-08
45	-0.931E-09	-0.18E-08	-0.28E-08
46	-0.138E-08	-0.88E-09	-0.23E-08
47	-0.173E-08	-0.24E-09	-0.20E-08
48	-0.206E-08	0.98E-10	-0.20E-08

POT. VORT. EQN. COMP. S

HOUR	TIME DER	DIV*VOR	RES
44	-0.437E-09	-0.30E-08	-0.35E-08
45	-0.931E-09	-0.18E-08	-0.28E-08
46	-0.136E-08	-0.88E-09	-0.23E-08
47	-0.173E-08	-0.24E-09	-0.20E-08
48	-0.206E-08	0.98E-10	-0.20E-08
49	-0.238E-08	0.20E-09	-0.22E-08
50	-0.207E-08	0.10E-09	-0.20E-08
51	-0.447E-09	0.21E-10	-0.43E-09
52	0.162E-08	0.46E-10	0.17E-08
53	0.274E-08	0.13E-09	0.29E-08
54	0.273E-08	0.79E-10	0.28E-08
55	0.911E-09	-0.20E-09	0.71E-09
56	-0.208E-08	-0.80E-09	-0.29E-08
57	-0.343E-08	-0.14E-08	-0.48E-08
58	-0.317E-08	-0.18E-08	-0.49E-08
59	-0.303E-08	-0.20E-08	-0.50E-08
60	-0.296E-08	-0.20E-08	-0.49E-08
61	-0.261E-08	-0.18E-08	-0.45E-08
62	-0.283E-08	-0.16E-08	-0.45E-08
63	-0.163E-08	-0.11E-08	-0.27E-08
64	0.134E-08	-0.86E-09	0.48E-09
65	0.442E-08	-0.88E-09	0.35E-08
66	0.779E-08	-0.59E-09	0.72E-08
67	0.767E-08	0.33E-08	0.11E-07
68	0.492E-08	0.57E-08	0.11E-07
69	0.235E-08	0.73E-08	0.97E-08
70	0.334E-09	0.75E-08	0.79E-08
71	-0.200E-09	0.68E-08	0.66E-08
72	-0.395E-08	0.60E-08	0.21E-08
73	-0.589E-08	0.49E-08	-0.97E-09
74	-0.160E-08	0.36E-08	0.20E-08
75	-0.777E-09	0.28E-08	0.21E-08
76	-0.178E-08	0.21E-08	0.34E-09
77	-0.559E-10	0.15E-08	0.15E-08
78	0.702E-09	0.11E-08	0.18E-08
79	0.495E-10	0.68E-09	0.73E-09
80	-0.317E-09	0.16E-09	-0.16E-09
81	0.333E-09	-0.11E-08	-0.76E-09
82	0.728E-09	-0.18E-08	-0.11E-08
83	0.130E-09	-0.48E-09	-0.35E-09
84	0.333E-11	0.40E-09	0.40E-09
85	0.481E-11	0.56E-09	0.57E-09
86	-0.242E-09	0.70E-09	0.46E-09
87	-0.480E-09	0.76E-09	0.28E-09
88	-0.104E-08	0.80E-09	-0.24E-09
89	-0.681E-09	0.79E-09	0.11E-09
90	-0.484E-09	0.81E-09	0.33E-09
91	-0.984E-09	0.78E-09	-0.20E-09
92	-0.106E-08	0.73E-09	-0.33E-09
93	-0.952E-09	0.68E-09	-0.27E-09
94	-0.502E-09	0.62E-09	0.12E-09
95	-0.493E-09	0.57E-09	0.82E-10
96	-0.864E-09	0.51E-09	-0.35E-09
97	-0.600E-09	0.46E-09	-0.14E-09
98	-0.524E-09	0.43E-09	-0.92E-10
99	-0.571E-09	0.40E-09	-0.17E-09
100	-0.109E-09	0.36E-09	0.25E-09
101	0.103E-09	0.33E-09	0.43E-09
102	0.365E-09	0.30E-09	0.67E-09
103	0.804E-09	0.29E-09	0.11E-08
104	0.608E-09	0.27E-09	0.88E-09
105	0.737E-09	0.20E-09	0.94E-09
106	0.170E-08	0.21E-09	0.19E-08

Table B-7 DKP and the location of the center of mass for the small-scale cluster (without corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
14	-0.106E-02	-0.36E-03	-0.80E-03	0.93E-03	0.94E+05	0.22E+06
15	0.347E-03	0.46E-04	0.16E-03	-0.27E-03	0.96E+05	0.21E+06
16	0.997E-04	-0.43E-05	0.27E-04	-0.10E-03	0.97E+05	0.21E+06
17	0.234E-04	-0.16E-04	-0.36E-05	-0.66E-04	0.98E+05	0.21E+06
18	-0.162E-04	-0.22E-04	-0.15E-04	-0.52E-04	0.99E+05	0.20E+06
19	-0.397E-04	-0.27E-04	-0.13E-04	-0.45E-04	0.10E+06	0.20E+06
20	-0.519E-04	-0.34E-04	-0.14E-04	-0.40E-04	0.10E+06	0.20E+06
21	-0.540E-04	-0.41E-04	-0.44E-05	-0.35E-04	0.10E+06	0.19E+06
22	-0.472E-04	-0.48E-04	0.11E-04	-0.28E-04	0.10E+06	0.19E+06
23	-0.339E-04	-0.51E-04	0.28E-04	-0.20E-04	0.10E+06	0.19E+06
24	-0.209E-04	-0.50E-04	0.43E-04	-0.11E-04	0.10E+06	0.19E+06
25	-0.101E-04	-0.45E-04	0.52E-04	-0.25E-05	0.10E+06	0.18E+06
26	-0.314E-05	-0.36E-04	0.54E-04	0.32E-05	0.10E+06	0.18E+06
27	-0.537E-06	-0.27E-04	0.49E-04	0.82E-05	0.10E+06	0.18E+06
28	-0.331E-06	-0.18E-04	0.39E-04	0.13E-04	0.10E+06	0.18E+06
29	-0.517E-07	-0.85E-05	0.27E-04	0.15E-04	0.10E+06	0.17E+06
30	0.365E-06	-0.12E-05	0.12E-04	0.18E-04	0.10E+06	0.17E+06
31	-0.624E-06	0.38E-05	-0.44E-05	0.21E-04	0.10E+06	0.17E+06
32	-0.247E-05	0.95E-05	-0.18E-04	0.22E-04	0.10E+06	0.17E+06
33	-0.621E-05	0.13E-04	-0.32E-04	0.22E-04	0.10E+06	0.17E+06
34	-0.132E-04	0.15E-04	-0.43E-04	0.22E-04	0.10E+06	0.16E+06
35	-0.202E-04	0.16E-04	-0.52E-04	0.20E-04	0.10E+06	0.16E+06
36	-0.286E-04	0.15E-04	-0.57E-04	0.17E-04	0.10E+06	0.16E+06
37	-0.343E-04	0.11E-04	-0.55E-04	0.13E-04	0.10E+06	0.16E+06
38	-0.283E-04	0.15E-05	-0.39E-04	0.16E-05	0.10E+06	0.16E+06
39	-0.103E-04	-0.17E-04	-0.60E-05	-0.15E-04	0.10E+06	0.15E+06
40	0.250E-04	-0.39E-04	0.51E-04	-0.36E-04	0.10E+06	0.15E+06
41	0.435E-04	-0.65E-04	0.10E-03	-0.50E-04	0.10E+06	0.15E+06
42	0.353E-04	-0.33E-04	0.13E-03	-0.58E-04	0.10E+06	0.15E+06
43	0.103E-04	-0.57E-04	0.12E-03	-0.61E-04	0.10E+06	0.15E+06

71	0.124E-03	-0.11E-03	-0.34E-04	0.45E-04	0.88E+05	0.10E+06
72	0.862E-04	-0.61E-04	-0.12E-04	0.13E-04	0.87E+05	0.10E+06
73	0.456E-04	-0.30E-04	0.69E-05	-0.11E-04	0.86E+05	0.10E+06
74	0.660E-06	-0.13E-04	0.33E-04	-0.30E-04	0.85E+05	0.99E+05
75	-0.441E-04	-0.57E-04	0.49E-04	-0.84E-05	0.83E+05	0.98E+05
76	-0.102E-03	-0.57E-05	0.84E-04	-0.11E-03	0.82E+05	0.96E+05
77	-0.745E-03	0.13E-03	0.49E-03	-0.63E-03	0.81E+05	0.95E+05
78	0.362E-03	0.12E-04	-0.27E-03	0.24E-03	0.79E+05	0.94E+05
79	0.651E-04	-0.21E-04	-0.56E-04	0.68E-04	0.78E+05	0.93E+05
80	-0.890E-04	-0.78E-04	0.50E-04	-0.13E-04	0.76E+05	0.92E+05
81	-0.136E-03	-0.26E-03	0.25E-03	-0.13E-04	0.75E+05	0.90E+05
82	-0.787E-04	-0.28E-03	0.26E-03	0.89E-04	0.73E+05	0.89E+05
83	-0.842E-04	-0.24E-03	0.24E-03	0.17E-03	0.72E+05	0.89E+05
84	-0.355E-03	-0.36E-03	0.15E-03	0.25E-03	0.70E+05	0.88E+05
85	0.317E-03	-0.32E-03	0.23E-03	-0.14E-03	0.68E+05	0.87E+05
86	-0.172E-04	-0.45E-03	0.47E-03	0.91E-04	0.66E+05	0.86E+05
87	-0.109E-03	-0.30E-04	0.18E-03	-0.23E-03	0.65E+05	0.85E+05
88	0.127E-03	0.12E-03	-0.12E-03	-0.74E-04	0.63E+05	0.84E+05
89	0.510E-03	-0.48E-03	0.19E-03	0.60E-03	0.61E+05	0.83E+05
90	0.358E-04	-0.11E-03	0.10E-03	0.17E-04	0.59E+05	0.83E+05
91	-0.279E-03	-0.18E-03	0.28E-03	-0.22E-03	0.58E+05	0.82E+05
92	0.502E-03	-0.15E-03	-0.45E-04	0.50E-03	0.56E+05	0.81E+05
93	0.107E-03	-0.16E-03	0.10E-03	0.14E-03	0.54E+05	0.81E+05
94	0.163E-03	0.34E-04	-0.15E-03	0.15E-03	0.53E+05	0.80E+05
95	0.670E-04	0.35E-07	-0.39E-04	0.83E-04	0.51E+05	0.79E+05
96	0.239E-04	-0.67E-04	0.31E-04	0.65E-04	0.49E+05	0.79E+05
97	-0.791E-04	-0.11E-03	0.64E-04	-0.31E-04	0.48E+05	0.78E+05
98	-0.116E-04	-0.29E-03	0.24E-03	-0.69E-05	0.46E+05	0.77E+05
99	0.359E-04	-0.52E-04	0.35E-04	0.13E-03	0.44E+05	0.77E+05
100	-0.178E-04	-0.93E-04	0.49E-04	0.71E-04	0.43E+05	0.77E+05
101	0.147E-04	-0.17E-03	0.11E-03	-0.24E-05	0.41E+05	0.76E+05
102	-0.192E-05	-0.13E-03	0.62E-04	-0.93E-05	0.40E+05	0.75E+05
103	0.342E-04	-0.66E-04	0.11E-03	-0.39E-04	0.38E+05	0.75E+05
104	-0.199E-04	-0.28E-04	0.94E-04	-0.89E-04	0.37E+05	0.74E+05
105	-0.829E-04	-0.63E-04	0.43E-04	-0.11E-03	0.35E+05	0.74E+05
106	-0.365E-03	0.23E-04	[illegible]	-0.30E-03	0.33E+05	0.74E+05
107	0.113E-02	-0.46E-03	0.21E-03	0.13E-02	0.31E+05	0.73E+05

Table B-7 continued.

Table B-8 DKP and the location of the center of mass for the small-scale cluster (with corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
14	0.131E-03	0.45E-04	0.98E-04	-0.11E-03	0.94E+05	0.22E+06
15	-0.423E-03	-0.56E-04	-0.20E-03	0.32E-03	0.96E+05	0.21E+06
16	0.216E-03	-0.95E-05	0.59E-04	-0.22E-03	0.97E+05	0.21E+06
17	0.377E-04	-0.25E-04	-0.57E-05	-0.11E-03	0.98E+05	0.21E+06
18	-0.256E-04	-0.34E-04	-0.24E-04	-0.81E-04	0.99E+05	0.20E+06
19	-0.581E-04	-0.47E-04	-0.31E-04	-0.76E-04	0.10E+06	0.20E+06
20	-0.107E-03	-0.70E-04	-0.30E-04	-0.82E-04	0.10E+06	0.20E+06
21	-0.150E-03	-0.11E-03	-0.12E-04	-0.96E-04	0.10E+06	0.19E+06
22	-0.200E-03	-0.20E-03	0.45E-04	-0.12E-03	0.10E+06	0.19E+06
23	-0.199E-03	-0.30E-03	0.17E-03	-0.12E-03	0.10E+06	0.19E+06
24	-0.116E-03	-0.28E-03	0.24E-03	-0.59E-04	0.10E+06	0.19E+06
25	-0.451E-04	-0.20E-03	0.23E-03	-0.11E-04	0.10E+06	0.18E+06
26	-0.116E-04	-0.13E-03	0.20E-03	0.12E-04	0.10E+06	0.18E+06
27	-0.191E-05	-0.93E-04	0.17E-03	0.28E-04	0.10E+06	0.18E+06
28	-0.132E-05	-0.67E-04	0.14E-03	0.47E-04	0.10E+06	0.18E+06
29	-0.372E-06	-0.37E-04	0.12E-03	0.70E-04	0.10E+06	0.17E+06
30	0.133E-05	-0.65E-05	0.68E-04	0.10E-03	0.10E+06	0.17E+06
31	-0.477E-05	0.27E-04	-0.31E-04	0.15E-03	0.10E+06	0.17E+06
32	-0.269E-04	0.10E-03	-0.20E-03	0.23E-03	0.10E+06	0.17E+06
33	-0.151E-03	0.31E-03	-0.77E-03	0.53E-03	0.10E+06	0.17E+06
34	0.226E-03	-0.26E-03	0.74E-03	-0.38E-03	0.10E+06	0.16E+06
35	0.844E-04	-0.67E-04	0.21E-03	-0.83E-04	0.10E+06	0.16E+05
36	0.539E-04	-0.27E-04	0.11E-03	-0.32E-04	0.10E+06	0.16E+06
37	0.332E-04	-0.11E-04	0.53E-04	-0.13E-04	0.10E+06	0.16E+06
38	0.172E-04	-0.81E-06	0.24E-04	-0.99E-06	0.10E+06	0.16E+06
39	0.505E-05	0.86E-05	0.30E-05	0.76E-05	0.10E+06	0.15E+06
40	-0.144E-04	0.22E-04	-0.29E-04	0.20E-04	0.10E+06	0.15E+06
41	-0.551E-04	0.81E-04	-0.13E-03	0.64E-04	0.10E+06	0.15E+06
42	-0.175E-03	0.43E-03	-0.63E-03	0.28E-03	0.10E+06	0.15E+06
43	-0.595E-04	0.33E-03	-0.67E-03	0.36E-03	0.10E+06	0.15E+06
44	0.516E-04	0.15E-04	-0.18E-03	0.14E-03	0.10E+06	0.14E+06
45	0.443E-04	-0.46E-04	-0.32E-04	0.68E-04	0.10E+06	0.14E+06
46	0.304E-04	-0.67E-04	0.21E-05	0.58E-04	0.10E+06	0.14E+06
47	0.238E-04	-0.51E-04	-0.15E-05	0.46E-04	0.99E+05	0.14E+06
48	0.152E-04	-0.35E-04	-0.34E-05	0.32E-04	0.99E+05	0.14E+06
49	0.987E-05	-0.20E-04	-0.44E-05	0.18E-04	0.99E+05	0.14E+06
50	0.546E-05	-0.50E-05	-0.36E-05	0.33E-05	0.99E+05	0.13E+06
51	0.799E-06	0.21E-06	-0.11E-05	-0.50E-06	0.98E+05	0.13E+06
52	-0.843E-07	0.39E-05	0.43E-05	-0.19E-05	0.98E+05	0.13E+06
53	-0.315E-05	-0.41E-05	-0.40E-05	0.34E-05	0.98E+05	0.13E+06
54	-0.723E-04	-0.52E-04	-0.59E-04	0.44E-04	0.97E+05	0.13E+06
55	-0.217E-03	-0.68E-04	-0.14E-03	0.53E-04	0.97E+05	0.13E+06
56	-0.622E-03	-0.22E-03	-0.38E-03	0.18E-03	0.96E+05	0.12E+06
57	-0.408E-01	-0.23E-01	-0.21E-01	0.21E-01	0.96E+05	0.12E+06
58	0.234E-03	0.95E-04	-0.60E-05	-0.96E-04	0.95E+05	0.12E+06
59	0.560E-04	0.16E-04	-0.40E-04	-0.22E-04	0.95E+05	0.12E+06
60	-0.270E-04	-0.32E-05	-0.45E-04	-0.54E-05	0.95E+05	0.12E+06
61	-0.996E-04	0.12E-04	-0.51E-04	-0.27E-04	0.94E+05	0.12E+06
62	-0.195E-03	-0.61E-04	-0.10E-03	0.27E-04	0.94E+05	0.12E+06
63	-0.535E-03	-0.29E-03	-0.28E-03	0.19E-03	0.93E+05	0.11E+06
64	0.665E-03	0.53E-03	0.37E-03	-0.38E-03	0.93E+05	0.11E+06
65	0.225E-03	0.20E-03	0.12E-03	-0.14E-03	0.92E+05	0.11E+06
66	0.996E-04	0.83E-04	0.41E-04	-0.48E-04	0.92E+05	0.11E+06
67	0.375E-04	0.66E-04	0.24E-04	-0.43E-04	0.91E+05	0.11E+06
68	0.709E-05	0.47E-04	0.15E-04	-0.31E-04	0.90E+05	0.11E+06
69	-0.998E-05	0.41E-04	0.12E-04	-0.26E-04	0.90E+05	0.11E+06
70	-0.259E-04	0.45E-04	0.15E-04	-0.25E-04	0.89E+05	0.10E+06
71	-0.630E-04	0.58E-04	0.18E-04	-0.22E-04	0.88E+05	0.10E+06
72	-0.103E-03	0.73E-04	0.15E-04	-0.15E-04	0.87E+05	0.10E+06
73	-0.132E-03	0.85E-04	-0.20E-04	0.32E-04	0.86E+05	0.10E+06
74	-0.222E-05	0.41E-04	-0.11E-03	0.99E-04	0.85E+05	0.99E+05

Table B-8 DKP and the location of the center of mass for the small-scale cluster (with corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
14	0.131E-03	0.45E-04	0.98E-04	-0.11E-03	0.94E+05	0.22E+06
15	-0.423E-03	-0.56E-04	-0.20E-03	0.32E-03	0.96E+05	0.21E+06
16	0.216E-03	-0.95E-05	0.59E-04	-0.22E-03	0.97E+05	0.21E+06
17	0.377E-04	-0.25E-04	-0.57E-05	-0.11E-03	0.98E+05	0.21E+06
18	-0.256E-04	-0.34E-04	-0.24E-04	-0.81E-04	0.99E+05	0.20E+06
19	-0.581E-04	-0.47E-04	-0.31E-04	-0.76E-04	0.10E+06	0.20E+06
20	-0.107E-03	-0.70E-04	-0.30E-04	-0.82E-04	0.10E+06	0.20E+06
21	-0.150E-03	-0.11E-03	-0.12E-04	-0.96E-04	0.10E+06	0.19E+06
22	-0.200E-03	-0.20E-03	0.45E-04	-0.12E-03	0.10E+06	0.19E+06
23	-0.199E-03	-0.30E-03	0.17E-03	-0.12E-03	0.10E+06	0.19E+06
24	-0.116E-03	-0.28E-03	0.24E-03	-0.59E-04	0.10E+06	0.19E+06
25	-0.451E-04	-0.20E-03	0.23E-03	-0.11E-04	0.10E+06	0.18E+06
26	-0.116E-04	-0.13E-03	0.20E-03	0.12E-04	0.10E+06	0.18E+06
27	-0.191E-05	-0.93E-04	0.17E-03	0.28E-04	0.10E+06	0.18E+06
28	-0.132E-05	-0.67E-04	0.14E-03	0.47E-04	0.10E+06	0.18E+06
29	-0.372E-06	-0.37E-04	0.12E-03	0.70E-04	0.10E+06	0.17E+06
30	0.133E-05	-0.65E-05	0.68E-04	0.10E-03	0.10E+06	0.17E+06
31	-0.477E-05	0.27E-04	-0.31E-04	0.15E-03	0.10E+06	0.17E+06
32	-0.269E-04	0.10E-03	-0.20E-03	0.23E-03	0.10E+06	0.17E+06
33	-0.151E-03	0.31E-03	-0.77E-03	0.53E-03	0.10E+06	0.17E+06
34	0.226E-03	-0.26E-03	0.74E-03	-0.38E-03	0.10E+06	0.16E+06
35	0.844E-04	-0.67E-04	0.21E-03	-0.83E-04	0.10E+06	0.16E+06
36	0.539E-04	-0.27E-04	0.11E-03	-0.32E-04	0.10E+06	0.16E+06
37	0.332E-04	-0.11E-04	0.53E-04	-0.13E-04	0.10E+06	0.16E+06
38	0.172E-04	-0.81E-06	0.24E-04	-0.99E-06	0.10E+06	0.16E+06
39	0.505E-05	0.86E-05	0.30E-05	0.76E-05	0.10E+06	0.15E+06
40	-0.144E-04	0.22E-04	-0.29E-04	0.20E-04	0.10E+06	0.15E+06
41	-0.551E-04	0.81E-04	-0.13E-03	0.64E-04	0.10E+06	0.15E+06
42	-0.175E-03	0.43E-03	-0.63E-03	0.28E-03	0.10E+06	0.15E+06
43	-0.595E-04	0.33E-03	-0.67E-03	0.36E-03	0.10E+06	0.15E+06
44	0.516E-04	0.15E-04	-0.18E-03	0.14E-03	0.10E+06	0.14E+06
45	0.443E-04	-0.46E-04	-0.32E-04	0.68E-04	0.10E+06	0.14E+06
46	0.304E-04	-0.67E-04	0.21E-05	0.58E-04	0.10E+06	0.14E+06
47	0.238E-04	-0.51E-04	-0.15E-05	0.46E-04	0.99E+05	0.14E+06
48	0.152E-04	-0.35E-04	-0.34E-05	0.32E-04	0.99E+05	0.14E+06
49	0.987E-05	-0.20E-04	-0.44E-05	0.18E-04	0.99E+05	0.14E+06
50	0.546E-05	-0.50E-05	-0.36E-05	0.33E-05	0.99E+05	0.13E+06
51	0.799E-06	0.21E-06	-0.11E-05	-0.50E-06	0.98E+05	0.13E+06
52	-0.843E-07	0.39E-05	0.43E-05	-0.19E-05	0.98E+05	0.13E+06
53	-0.315E-05	-0.41E-05	-0.40E-05	0.34E-05	0.98E+05	0.13E+06
54	-0.723E-04	-0.52E-04	-0.59E-04	0.44E-04	0.97E+05	0.13E+06
55	-0.217E-03	-0.68E-04	-0.14E-03	0.53E-04	0.97E+05	0.13E+06
56	-0.622E-03	-0.22E-03	-0.38E-03	0.18E-03	0.96E+05	0.12E+06
57	-0.408E-01	-0.23E-01	-0.21E-01	0.21E-01	0.96E+05	0.12E+06
58	0.234E-03	0.95E-04	-0.60E-05	-0.96E-04	0.95E+05	0.12E+06
59	0.560E-04	0.16E-04	-0.40E-04	-0.22E-04	0.95E+05	0.12E+06
60	-0.270E-04	-0.32E-05	-0.45E-04	-0.54E-05	0.95E+05	0.12E+06
61	-0.996E-04	0.12E-04	-0.51E-04	-0.27E-04	0.94E+05	0.12E+06
62	-0.195E-03	-0.61E-04	-0.10E-03	0.27E-04	0.94E+05	0.12E+06
63	-0.535E-03	-0.29E-03	-0.28E-03	0.19E-03	0.93E+05	0.11E+06
64	0.665E-03	0.53E-03	0.37E-03	-0.38E-03	0.93E+05	0.11E+06
65	0.225E-03	0.20E-03	0.12E-03	-0.14E-03	0.92E+05	0.11E+06
66	0.996E-04	0.83E-04	0.41E-04	-0.48E-04	0.92E+05	0.11E+06
67	0.375E-04	0.66E-04	0.24E-04	-0.43E-04	0.91E+05	0.11E+06
68	0.709E-05	0.47E-04	0.15E-04	-0.31E-04	0.90E+05	0.11E+06
69	-0.998E-05	0.41E-04	0.12E-04	-0.26E-04	0.90E+05	0.11E+06
70	-0.259E-04	0.45E-04	0.15E-04	-0.25E-04	0.89E+05	0.10E+06
71	-0.630E-04	0.58E-04	0.18E-04	-0.22E-04	0.88E+05	0.10E+06
72	-0.103E-03	0.73E-04	0.15E-04	-0.15E-04	0.87E+05	0.10E+06
73	-0.132E-03	0.85E-04	-0.20E-04	0.32E-04	0.86E+05	0.10E+06
74	-0.222E-05	0.41E-04	-0.11E-03	0.99E-04	0.85E+05	0.99E+05

Table B-9 DKP and the location of the center of mass for the large-scale cluster using every 4th data point (without corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
46	-0.166E-04	0.24E-04	0.31E-04	-0.32E-04	0.10E+06	0.14E+06
50	-0.714E-07	0.38E-05	0.22E-04	-0.11E-04	0.10E+06	0.13E+06
54	-0.190E-05	0.43E-05	0.27E-04	-0.12E-04	0.10E+06	0.13E+06
58	-0.183E-04	-0.74E-06	0.34E-04	-0.84E-05	0.10E+06	0.12E+06
62	-0.279E-04	-0.24E-04	0.36E-04	0.13E-04	0.10E+06	0.11E+06
66	0.325E-05	-0.68E-05	-0.17E-05	0.46E-05	0.10E+06	0.11E+06
70	0.385E-04	0.22E-04	-0.41E-04	-0.10E-04	0.97E+05	0.10E+06
74	0.314E-04	0.83E-05	-0.25E-04	0.39E-05	0.94E+05	0.97E+05
78	0.101E-04	-0.18E-05	0.19E-05	0.52E-05	0.89E+05	0.92E+05
82	-0.141E-05	-0.85E-06	0.13E-04	-0.36E-05	0.84E+05	0.88E+05
86	0.496E-05	-0.13E-05	0.55E-05	-0.34E-05	0.78E+05	0.84E+05
90	0.101E-04	-0.92E-05	-0.29E-06	0.64E-05	0.71E+05	0.81E+05
94	0.982E-05	-0.19E-04	-0.17E-06	0.17E-04	0.65E+05	0.77E+05
98	0.829E-05	-0.28E-04	0.22E-05	0.26E-04	0.58E+05	0.75E+05
102	0.609E-05	-0.29E-04	0.56E-05	0.26E-04	0.52E+05	0.72E+05

75	0.682E-04	0.88E-04	-0.75E-04	0.13E-04	0.83E+05	0.98E+05
76	0.796E-04	0.43E-05	-0.66E-04	0.87E-04	0.82E+05	0.96E+05
77	0.302E-04	-0.52E-05	-0.20E-04	0.26E-04	0.81E+05	0.95E+05
78	-0.611E-04	-0.21E-05	0.45E-04	-0.40E-04	0.79E+05	0.94E+05
79	-0.943E-04	0.30E-04	0.81E-04	-0.99E-04	0.78E+05	0.93E+05
80	0.142E-03	0.13E-03	-0.80E-04	0.21E-04	0.76E+05	0.92E+05
81	0.317E-04	0.61E-04	-0.58E-04	0.30E-05	0.75E+05	0.90E+05
82	0.145E-04	0.51E-04	-0.47E-04	-0.16E-04	0.73E+05	0.89E+05
83	0.848E-05	0.25E-04	-0.24E-04	-0.17E-04	0.72E+05	0.89E+05
84	0.219E-04	0.23E-04	-0.97E-05	-0.16E-04	0.70E+05	0.88E+05
85	-0.177E-04	0.18E-04	-0.13E-04	0.80E-05	0.68E+05	0.87E+05
86	0.660E-06	0.17E-04	-0.17E-04	-0.34E-05	0.66E+05	0.86E+05
87	0.359E-04	0.96E-05	-0.59E-04	0.77E-04	0.65E+05	0.85E+05
88	-0.535E-04	-0.50E-04	0.51E-04	0.31E-04	0.63E+05	0.84E+05
89	-0.827E-04	0.78E-04	-0.31E-04	-0.97E-04	0.61E+05	0.83E+05
90	-0.147E-04	0.45E-04	-0.42E-04	-0.69E-05	0.59E+05	0.83E+05
91	0.489E-04	0.31E-04	-0.49E-04	0.38E-04	0.58E+05	0.82E+05
92	-0.308E-04	0.91E-05	0.28E-05	-0.31E-04	0.56E+05	0.81E+05
93	-0.459E-04	0.67E-04	-0.44E-04	-0.60E-04	0.54E+05	0.81E+05
94	-0.110E-03	-0.57E-04	0.99E-04	-0.10E-03	0.53E+05	0.80E+05
95	0.363E-03	0.39E-06	-0.21E-03	0.48E-03	0.51E+05	0.79E+05
96	0.834E-04	-0.23E-03	0.11E-03	0.23E-03	0.49E+05	0.79E+05
97	-0.195E-03	-0.28E-03	0.16E-03	-0.75E-04	0.48E+05	0.78E+05
98	0.135E-04	0.33E-03	-0.27E-03	0.80E-05	0.46E+05	0.77E+05
99	0.190E-03	-0.27E-03	0.18E-03	0.70E-03	0.44E+05	0.77E+05
100	0.556E-03	0.29E-02	-0.15E-02	-0.22E-02	0.43E+05	0.77E+05
101	-0.112E-03	0.13E-02	-0.81E-03	0.18E-04	0.41E+05	0.76E+05
102	0.442E-05	0.44E-03	-0.15E-03	0.23E-04	0.40E+05	0.75E+05
103	-0.637E-04	0.12E-03	-0.21E-03	0.73E-04	0.38E+05	0.75E+05
104	0.127E-04	0.18E-04	-0.60E-04	0.57E-04	0.37E+05	0.74E+05
105	0.302E-04	0.23E-04	-0.16E-04	0.40E-04	0.35E+05	0.74E+05
106	0.261E-04	-0.16E-05	-0.60E-05	0.22E-04	0.33E+05	0.74E+05
107	-0.166E-04	0.67E-05	-0.31E-05	-0.20E-04	0.31E+05	0.73E+05

Table B-8 continued.

Table B-10 DKP for the large-scale cluster using every 4th data point (without corrections for position errors). This data is for a natural coordinate system.

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
46	-0.186E+03	0.50E+00	0.37E-04	-0.25E-04
50	-0.185E+03	0.49E+00	0.24E-04	-0.74E-05
54	-0.188E+03	0.46E+00	0.29E-04	-0.43E-05
58	-0.191E+03	0.43E+00	0.35E-04	0.49E-05
62	-0.193E+03	0.40E+00	0.26E-04	0.27E-04
66	-0.200E+03	0.40E+00	-0.43E-05	0.24E-05
70	-0.209E+03	0.42E+00	-0.13E-04	-0.40E-04
74	-0.218E+03	0.46E+00	-0.10E-04	-0.23E-04
78	-0.227E+03	0.48E+00	-0.53E-05	0.16E-05
82	-0.235E+03	0.49E+00	-0.13E-05	0.14E-04
86	-0.240E+03	0.50E+00	0.26E-06	0.65E-05
90	-0.243E+03	0.50E+00	-0.51E-05	-0.39E-05
94	-0.245E+03	0.50E+00	-0.13E-04	-0.11E-04
98	-0.249E+03	0.49E+00	-0.19E-04	-0.17E-04
102	-0.252E+03	0.50E+00	-0.20E-04	-0.18E-04

Table B-9 DKP and the location of the center of mass for the large-scale cluster using every 4th data point (without corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
46	-0.166E-04	0.24E-04	0.31E-04	-0.32E-04	0.10E+06	0.14E+06
50	-0.714E-07	0.38E-05	0.22E-04	-0.11E-04	0.10E+06	0.13E+06
54	-0.190E-05	0.43E-05	0.27E-04	-0.12E-04	0.10E+06	0.13E+06
58	-0.183E-04	-0.74E-06	0.34E-04	-0.84E-05	0.10E+06	0.12E+06
62	-0.279E-04	-0.24E-04	0.36E-04	0.13E-04	0.10E+06	0.11E+06
66	0.325E-05	-0.68E-05	-0.17E-05	0.46E-05	0.10E+06	0.11E+06
70	0.385E-04	0.22E-04	-0.41E-04	-0.10E-04	0.97E+05	0.10E+06
74	0.314E-04	0.83E-05	-0.25E-04	0.39E-05	0.94E+05	0.97E+05
78	0.101E-04	-0.18E-05	0.19E-05	0.52E-05	0.89E+05	0.92E+05
82	-0.141E-05	-0.85E-06	0.13E-04	-0.36E-05	0.84E+05	0.88E+05
86	0.496E-05	-0.13E-05	0.55E-05	-0.34E-05	0.78E+05	0.84E+05
90	0.101E-04	-0.92E-05	-0.29E-06	0.64E-05	0.71E+05	0.81E+05
94	0.982E-05	-0.19E-04	-0.17E-06	0.17E-04	0.65E+05	0.77E+05
98	0.829E-05	-0.28E-04	0.22E-05	0.26E-04	0.58E+05	0.75E+05
102	0.609E-05	-0.29E-04	0.56E-05	0.26E-04	0.52E+05	0.72E+05

Table B-11 Potential vorticity equation components for the large-scale cluster using every 4th data point (without corrections for position errors).

Pot. Vort. Eqn. Comp. s

Hour	Time Der	Div*Vor	Res
50	-0.700E-09	-0.60E-11	-0.71E-09
54	-0.167E-09	-0.16E-09	-0.33E-09
58	-0.980E-09	-0.14E-08	-0.24E-08
62	-0.217E-09	-0.16E-08	-0.18E-08
66	0.160E-08	0.24E-09	0.18E-08
70	0.515E-09	0.39E-08	0.44E-08
74	-0.851E-09	0.27E-08	0.19E-08
78	-0.323E-09	0.78E-09	0.46E-09
82	0.126E-10	-0.11E-09	-0.98E-10
86	-0.294E-09	0.38E-09	0.91E-10
90	-0.629E-09	0.70E-09	0.75E-10
94	-0.651E-09	0.58E-09	-0.67E-10
98	-0.339E-09	0.42E-09	0.83E-10

Table B-10 DKP for the large-scale cluster using every 4th data point (without corrections for position errors). This data is for a natural coordinate system.

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
46	-0.186E+03	0.50E+00	0.37E-04	-0.25E-04
50	-0.185E+03	0.49E+00	0.24E-04	-0.74E-05
54	-0.188E+03	0.46E+00	0.29E-04	-0.43E-05
58	-0.191E+03	0.43E+00	0.35E-04	0.49E-05
62	-0.193E+03	0.40E+00	0.26E-04	0.27E-04
66	-0.200E+03	0.40E+00	-0.43E-05	0.24E-05
70	-0.209E+03	0.42E+00	-0.13E-04	-0.40E-04
74	-0.218E+03	0.46E+00	-0.10E-04	-0.23E-04
78	-0.227E+03	0.48E+00	-0.53E-05	0.16E-05
82	-0.235E+03	0.49E+00	-0.13E-05	0.14E-04
86	-0.240E+03	0.50E+00	0.26E-06	0.65E-05
90	-0.243E+03	0.50E+00	-0.51E-05	-0.39E-05
94	-0.245E+03	0.50E+00	-0.13E-04	-0.11E-04
98	-0.249E+03	0.49E+00	-0.19E-04	-0.17E-04
102	-0.252E+03	0.50E+00	-0.20E-04	-0.18E-04

Table B-12 DKP and the location of the center of mass for the large-scale cluster using every 4th data point (with corections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
46	-0.173E-04	0.25E-04	0.32E-04	-0.33E-04	0.10E+06	0.14E+05
50	-0.765E-07	0.40E-05	0.23E-04	-0.12E-04	0.10E+06	0.13E+06
54	-0.205E-05	0.46E-05	0.29E-04	-0.13E-04	0.10E+06	0.13E+06
58	-0.211E-04	-0.85E-06	0.40E-04	-0.97E-05	0.10E+06	0.12E+06
62	-0.425E-04	-0.36E-04	0.54E-04	0.19E-04	0.10E+06	0.11E+06
66	0.836E-05	-0.17E-04	-0.45E-05	0.12E-04	0.10E+06	0.11E+06
70	0.555E-04	0.32E-04	-0.59E-04	-0.15E-04	0.97E+05	0.10E+06
74	0.348E-04	0.92E-05	-0.27E-04	0.44E-05	0.94E+05	0.97E+05
78	0.106E-04	-0.19E-05	0.20E-05	0.55E-05	0.89E+05	0.92E+05
82	-0.151E-05	-0.91E-06	0.14E-04	-0.39E-05	0.84E+05	0.88E+05
86	0.540E-05	-0.14E-05	0.60E-05	-0.37E-05	0.78E+05	0.84E+05
90	0.109E-04	-0.99E-05	-0.32E-06	0.69E-05	0.71E+05	0.81E+05
94	0.104E-04	-0.20E-04	-0.18E-06	0.18E-04	0.65E+05	0.77E+05
98	0.868E-05	-0.29E-04	0.23E-05	0.27E-04	0.58E+05	0.75E+05
102	0.631E-05	-0.30E-04	0.58E-05	0.27E-04	0.52E+05	0.72E+05

Table B-11 Potential vorticity equation components for the large-scale cluster using every 4th data point (without corrections for position errors).

Pot. Vort. Eqn. Comp. s

Hour	Time Der	Div*Vor	Res
50	-0.700E-09	-0.60E-11	-0.71E-09
54	-0.167E-09	-0.16E-09	-0.33E-09
58	-0.980E-09	-0.14E-08	-0.24E-08
62	-0.217E-09	-0.16E-08	-0.18E-08
66	0.160E-08	0.24E-09	0.18E-08
70	0.515E-09	0.39E-08	0.44E-08
74	-0.851E-09	0.27E-08	0.19E-08
78	-0.323E-09	0.78E-09	0.46E-09
82	0.126E-10	-0.11E-09	-0.98E-10
86	-0.294E-09	0.38E-09	0.91E-10
90	-0.629E-09	0.70E-09	0.75E-10
94	-0.651E-09	0.58E-09	-0.67E-10
98	-0.339E-09	0.42E-09	0.83E-10

Table B-13 DKP for the large-scale cluster using every 4th data point (with corrections for position errors). This data is for a natural coordinate system.

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
46	-0.186E+03	0.50E+00	0.39E-04	-0.26E-04
50	-0.185E+03	0.49E+00	0.25E-04	-0.78E-05
54	-0.188E+03	0.46E+00	0.31E-04	-0.46E-05
58	-0.191E+03	0.43E+00	0.41E-04	0.57E-05
62	-0.193E+03	0.40E+00	0.40E-04	0.41E-04
66	-0.200E+03	0.40E+00	-0.11E-04	0.63E-05
70	-0.209E+03	0.42E+00	-0.19E-04	-0.58E-04
74	-0.218E+03	0.46E+00	-0.11E-04	-0.25E-04
78	-0.227E+03	0.48E+00	-0.56E-05	0.17E-05
82	-0.235E+03	0.49E+00	-0.14E-05	0.15E-04
86	-0.240E+03	0.50E+00	0.28E-06	0.70E-05
90	-0.243E+03	0.50E+00	-0.55E-05	-0.42E-05
94	-0.245E+03	0.50E+00	-0.14E-04	-0.12E-04
98	-0.249E+03	0.49E+00	-0.20E-04	-0.18E-04
102	-0.252E+03	0.50E+00	-0.20E-04	-0.19E-04

Table B-12 DKP and the location of the center of mass for the large-scale cluster using every 4th data point (with corections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
46	-0.173E-04	0.25E-04	0.32E-04	-0.33E-04	0.10E+06	0.14E+05
50	-0.765E-07	0.40E-05	0.23E-04	-0.12E-04	0.10E+06	0.13E+06
54	-0.205E-05	0.46E-05	0.29E-04	-0.13E-04	0.10E+06	0.13E+06
58	-0.211E-04	-0.85E-06	0.40E-04	-0.97E-05	0.10E+06	0.12E+06
62	-0.425E-04	-0.36E-04	0.54E-04	0.19E-04	0.10E+06	0.11E+06
66	0.836E-05	-0.17E-04	-0.45E-05	0.12E-04	0.10E+06	0.11E+06
70	0.555E-04	0.32E-04	-0.59E-04	-0.15E-04	0.97E+05	0.10E+06
74	0.348E-04	0.92E-05	-0.27E-04	0.44E-05	0.94E+05	0.97E+05
78	0.106E-04	-0.19E-05	0.20E-05	0.55E-05	0.89E+05	0.92E+05
82	-0.151E-05	-0.91E-06	0.14E-04	-0.39E-05	0.84E+05	0.88E+05
86	0.540E-05	-0.14E-05	0.60E-05	-0.37E-05	0.78E+05	0.84E+05
90	0.109E-04	-0.99E-05	-0.32E-06	0.69E-05	0.71E+05	0.81E+05
94	0.104E-04	-0.20E-04	-0.18E-06	0.18E-04	0.65E+05	0.77E+05
98	0.868E-05	-0.29E-04	0.23E-05	0.27E-04	0.58E+05	0.75E+05
102	0.631E-05	-0.30E-04	0.58E-05	0.27E-04	0.52E+05	0.72E+05

Table B-14 Potential vorticity equation components for the large-scale cluster using every 4th data point (with corrections for position errors).

Hour	Time Der	Div*Vor	Res
50	-0.722E-09	-0.64E-11	-0.73E-09
54	-0.178E-09	-0.17E-09	-0.35E-09
58	-0.142E-08	-0.17E-08	-0.31E-08
62	-0.581E-09	-0.18E-08	-0.24E-08
66	0.237E-08	0.52E-09	0.29E-08
70	0.914E-09	0.62E-08	0.71E-08
74	-0.120E-08	0.31E-08	0.19E-08
78	-0.356E-09	0.82E-09	0.46E-09
82	0.121E-10	-0.12E-09	-0.11E-09
86	-0.316E-09	0.42E-09	0.10E-09
90	-0.665E-09	0.75E-09	0.85E-10
94	-0.672E-09	0.61E-09	-0.65E-10
98	-0.336E-09	0.43E-09	0.94E-10

Table B-13 DKP for the large-scale cluster using every 4th data point (with corrections for position errors). This data is for a natural coordinate system.

THE FOLLOWING ARE PARAMETERS OF THE NATURAL SYSTEM

HOUR	ALPHA	SPEED	N DEF	S DEF
46	-0.186E+03	0.50E+00	0.39E-04	-0.26E-04
50	-0.185E+03	0.49E+00	0.25E-04	-0.78E-05
54	-0.188E+03	0.46E+00	0.31E-04	-0.46E-05
58	-0.191E+03	0.43E+00	0.41E-04	0.57E-05
62	-0.193E+03	0.40E+00	0.40E-04	0.41E-04
66	-0.200E+03	0.40E+00	-0.11E-04	0.63E-05
70	-0.209E+03	0.42E+00	-0.19E-04	-0.58E-04
74	-0.218E+03	0.46E+00	-0.11E-04	-0.25E-04
78	-0.227E+03	0.48E+00	-0.56E-05	0.17E-05
82	-0.235E+03	0.49E+00	-0.14E-05	0.15E-04
86	-0.240E+03	0.50E+00	0.28E-06	0.70E-05
90	-0.243E+03	0.50E+00	-0.55E-05	-0.42E-05
94	-0.245E+03	0.50E+00	-0.14E-04	-0.12E-04
98	-0.249E+03	0.49E+00	-0.20E-04	-0.18E-04
102	-0.252E+03	0.50E+00	-0.20E-04	-0.19E-04

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
17	0.746E-04	-0.22E-05	0.35E-04	-0.66E-04	0.98E+05	0.21E+06
21	-0.395E-04	-0.36E-04	-0.11E-05	-0.36E-04	0.10E+06	0.19E+06
25	-0.145E-04	-0.42E-04	0.38E-04	-0.54E-05	0.10E+06	0.18E+06
29	-0.339E-05	-0.10E-04	0.22E-04	0.15E-04	0.10E+06	0.17E+06
33	-0.584E-05	0.10E-04	-0.24E-04	0.19E-04	0.10E+06	0.17E+06
37	-0.188E-04	0.21E-05	-0.28E-04	0.55E-05	0.10E+06	0.16E+06
41	0.289E-04	-0.39E-04	0.74E-04	-0.37E-04	0.10E+06	0.15E+05
45	-0.711E-04	0.24E-04	0.70E-04	-0.78E-04	0.10E+06	0.14E+06
49	-0.137E-03	0.29E-03	0.56E-04	-0.25E-03	0.99E+05	0.14E+06
53	0.201E-02	0.25E-02	0.24E-02	-0.21E-02	0.98E+05	0.13E+06
57	0.575E-04	0.27E-04	0.18E-04	-0.25E-04	0.96E+05	0.12E+06
61	-0.179E-04	-0.11E-04	-0.15E-04	0.63E-05	0.94E+05	0.12E+06
65	-0.103E-03	-0.87E-04	-0.47E-04	0.60E-04	0.92E+05	0.11E+06
69	0.597E-04	-0.35E-03	-0.10E-03	0.22E-03	0.90E+05	0.11E+06
73	0.321E-04	-0.33E-04	0.23E-04	-0.11E-04	0.86E+05	0.10E+06
77	-0.239E-03	0.32E-04	0.14E-03	-0.21E-03	0.81E+05	0.95E+05
81	-0.400E-04	-0.74E-04	0.21E-04	0.38E-04	0.75E+05	0.90E+05
85	0.237E-03	-0.30E-03	0.29E-03	-0.14E-03	0.68E+05	0.87E+05
89	-0.777E-04	-0.73E-04	0.13E-03	-0.11E-03	0.61E+05	0.83E+05
93	0.138E-03	-0.51E-05	-0.52E-04	0.12E-03	0.54E+05	0.81E+05
97	-0.234E-05	-0.55E-04	0.20E-04	0.49E-04	0.48E+05	0.78E+05
101	-0.404E-05	-0.12E-03	0.83E-04	0.60E-05	0.41E+05	0.76E+05

Table B-15 DKP and the location of the center of mass for the small-scale cluster using every 4th data point (without corrections for position errors). This data is for a geographic coordinate system.

Table B-14 Potential vorticity equation components for the large-scale cluster using every 4th data point (with corrections for position errors).

Hour	Time Der	Div*Vor	Res
50	-0.722E-09	-0.64E-11	-0.73E-09
54	-0.178E-09	-0.17E-09	-0.35E-09
58	-0.142E-08	-0.17E-08	-0.31E-08
62	-0.581E-09	-0.18E-08	-0.24E-08
66	0.237E-08	0.52E-09	0.29E-08
70	0.914E-09	0.62E-08	0.71E-08
74	-0.120E-08	0.31E-08	0.19E-08
78	-0.356E-09	0.82E-09	0.46E-09
82	0.121E-10	-0.12E-09	-0.11E-09
86	-0.316E-09	0.42E-09	0.10E-09
90	-0.665E-09	0.75E-09	0.85E-10
94	-0.672E-09	0.61E-09	-0.65E-10
98	-0.336E-09	0.43E-09	0.94E-10

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
17	0.120E-03	-0.36E-05	0.57E-04	-0.11E-03	0.98E+05	0.21E+06
21	-0.110E-03	-0.10E-03	-0.33E-05	-0.99E-04	0.10E+06	0.19E+06
25	-0.645E-04	-0.19E-03	0.17E-03	-0.24E-04	0.10E+06	0.18E+06
29	-0.151E-04	-0.46E-04	0.95E-04	0.65E-04	0.10E+06	0.17E+06
33	-0.167E-03	0.24E-03	-0.58E-03	0.46E-03	0.10E+06	0.17E+06
37	0.181E-04	-0.19E-05	0.27E-04	-0.54E-05	0.10E+06	0.16E+06
41	-0.367E-04	0.49E-04	-0.93E-04	0.46E-04	0.10E+06	0.15E+06
45	0.448E-04	-0.15E-04	-0.44E-04	0.49E-04	0.10E+06	0.14E+06
49	0.892E-05	-0.19E-04	-0.38E-05	0.16E-04	0.99E+05	0.14E+06
53	-0.329E-05	-0.41E-05	-0.40E-05	0.35E-05	0.98E+05	0.13E+06
57	-0.377E-01	-0.18E-01	-0.12E-01	0.16E-01	0.96E+05	0.12E+06
61	-0.589E-04	-0.37E-04	-0.50E-04	0.21E-04	0.94E+05	0.12E+06
65	0.212E-03	0.18E-03	0.96E-04	-0.12E-03	0.92E+05	0.11E+06
69	-0.674E-05	0.40E-04	0.12E-04	-0.25E-04	0.90E+05	0.11E+06
73	-0.929E-04	0.94E-04	-0.66E-04	0.31E-04	0.86E+05	0.10E+06
77	0.968E-05	-0.13E-05	-0.58E-05	0.83E-05	0.81E+05	0.95E+05
81	0.927E-05	0.17E-04	-0.49E-05	-0.90E-05	0.75E+05	0.90E+05
85	-0.133E-04	0.16E-04	-0.16E-04	0.81E-05	0.68E+05	0.87E+05
89	0.126E-04	0.12E-04	-0.21E-04	0.18E-04	0.61E+05	0.83E+05
93	-0.593E-04	0.22E-05	0.22E-04	-0.53E-04	0.54E+05	0.81E+05
97	-0.586E-05	-0.13E-03	0.43E-04	0.12E-03	0.48E+05	0.78E+05
101	0.305E-04	0.92E-03	-0.63E-03	-0.46E-04	0.41E+05	0.76E+05

Table B-16 DKP and the location of the center of mass for the small-scale cluster using every 4th data point (with corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
17	0.746E-04	-0.22E-05	0.35E-04	-0.66E-04	0.98E+05	0.21E+06
21	-0.395E-04	-0.36E-04	-0.11E-05	-0.36E-04	0.10E+06	0.19E+06
25	-0.145E-04	-0.42E-04	0.38E-04	-0.54E-05	0.10E+06	0.18E+06
29	-0.339E-05	-0.10E-04	0.22E-04	0.15E-04	0.10E+06	0.17E+06
33	-0.584E-05	0.10E-04	-0.24E-04	0.19E-04	0.10E+06	0.17E+06
37	-0.188E-04	0.21E-05	-0.28E-04	0.55E-05	0.10E+06	0.16E+06
41	0.289E-04	-0.39E-04	0.74E-04	-0.37E-04	0.10E+06	0.15E+05
45	-0.711E-04	0.24E-04	0.70E-04	-0.78E-04	0.10E+06	0.14E+06
49	-0.137E-03	0.29E-03	0.56E-04	-0.25E-03	0.99E+05	0.14E+06
53	0.201E-02	0.25E-02	0.24E-02	-0.21E-02	0.98E+05	0.13E+06
57	0.575E-04	0.27E-04	0.18E-04	-0.25E-04	0.96E+05	0.12E+06
61	-0.179E-04	-0.11E-04	-0.15E-04	0.63E-05	0.94E+05	0.12E+06
65	-0.103E-03	-0.87E-04	-0.47E-04	0.60E-04	0.92E+05	0.11E+06
69	0.597E-04	-0.35E-03	-0.10E-03	0.22E-03	0.90E+05	0.11E+06
73	0.321E-04	-0.33E-04	0.23E-04	-0.11E-04	0.86E+05	0.10E+06
77	-0.239E-03	0.32E-04	0.14E-03	-0.21E-03	0.81E+05	0.95E+05
81	-0.400E-04	-0.74E-04	0.21E-04	0.38E-04	0.75E+05	0.90E+05
85	0.237E-03	-0.30E-03	0.29E-03	-0.14E-03	0.68E+05	0.87E+05
89	-0.777E-04	-0.73E-04	0.13E-03	-0.11E-03	0.61E+05	0.83E+05
93	0.138E-03	-0.51E-05	-0.52E-04	0.12E-03	0.54E+05	0.81E+05
97	-0.234E-05	-0.55E-04	0.20E-04	0.49E-04	0.48E+05	0.78E+05
101	-0.404E-05	-0.12E-03	0.83E-04	0.60E-05	0.41E+05	0.76E+05

Table B-15 DKP and the location of the center of mass for the small-scale cluster using every 4th data point (without corrections for position errors). This data is for a geographic coordinate system.

HOUR	DIVER	VORTY	N DEF	S DEF	X CENTER	Y CENTER
17	0.120E-03	-0.36E-05	0.57E-04	-0.11E-03	0.98E+05	0.21E+06
21	-0.110E-03	-0.10E-03	-0.33E-05	-0.99E-04	0.10E+06	0.19E+06
25	-0.645E-04	-0.19E-03	0.17E-03	-0.24E-04	0.10E+06	0.18E+06
29	-0.151E-04	-0.46E-04	0.95E-04	0.65E-04	0.10E+06	0.17E+06
33	-0.167E-03	0.24E-03	-0.58E-03	0.46E-03	0.10E+06	0.17E+06
37	0.181E-04	-0.19E-05	0.27E-04	-0.54E-05	0.10E+06	0.16E+06
41	-0.367E-04	0.49E-04	-0.93E-04	0.46E-04	0.10E+06	0.15E+06
45	0.448E-04	-0.15E-04	-0.44E-04	0.49E-04	0.10E+06	0.14E+06
49	0.892E-05	-0.19E-04	-0.38E-05	0.16E-04	0.99E+05	0.14E+06
53	-0.329E-05	-0.41E-05	-0.40E-05	0.35E-05	0.98E+05	0.13E+06
57	-0.377E-01	-0.18E-01	-0.12E-01	0.16E-01	0.96E+05	0.12E+06
61	-0.589E-04	-0.37E-04	-0.50E-04	0.21E-04	0.94E+05	0.12E+06
65	0.212E-03	0.18E-03	0.96E-04	-0.12E-03	0.92E+05	0.11E+06
69	-0.674E-05	0.40E-04	0.12E-04	-0.25E-04	0.90E+05	0.11E+06
73	-0.929E-04	0.94E-04	-0.66E-04	0.31E-04	0.86E+05	0.10E+06
77	0.968E-05	-0.13E-05	-0.58E-05	0.83E-05	0.81E+05	0.95E+05
81	0.927E-05	0.17E-04	-0.49E-05	-0.90E-05	0.75E+05	0.90E+05
85	-0.133E-04	0.16E-04	-0.16E-04	0.81E-05	0.68E+05	0.87E+05
89	0.126E-04	0.12E-04	-0.21E-04	0.18E-04	0.61E+05	0.83E+05
93	-0.593E-04	0.22E-05	0.22E-04	-0.53E-04	0.54E+05	0.81E+05
97	-0.586E-05	-0.13E-03	0.43E-04	0.12E-03	0.48E+05	0.78E+05
[illegible]1	0.305E-04	0.92E-03	-0.63E-03	-0.46E-04	0.41E+05	0.76E+05

Table B-16 DKP and the location of the center of mass for the small-scale cluster using every 4th data point (with corrections for position errors). This data is for a geographic coordinate system.